AQA GCSE Physics | 8463

SPECIFICATION POINT 4.5.3

Forces and elasticity

Past-paper questions

Tier	**Foundation**
Question groups	**24**
Available paper years	**2003–2025**

Using this booklet

1. Answer the questions in order and show your working.
2. Original question numbers and marks are retained.
3. Print at actual size (100%) for measuring questions.
4. Use the companion answer booklet to check your work.

Name: _____ **Date:** _____

Whole questions are retained for context, so some parts assess other specification points. Current and legacy sources are labelled. Continue on extra paper if needed.

4.5.3 Forces and elasticity

Question 01

June 2003 | 3451F | Original Q3 | Legacy

3 (a) In the box are the names of five waves.

infra red	**microwaves**	**ultrasonic**	**ultraviolet**	**X-rays**

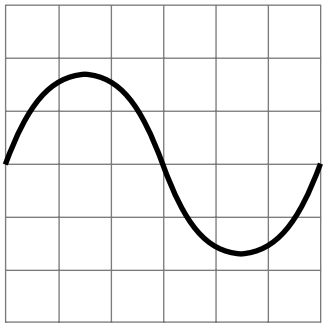
Which wave is used to:

(i) send information to a satellite, ...
(1 mark)

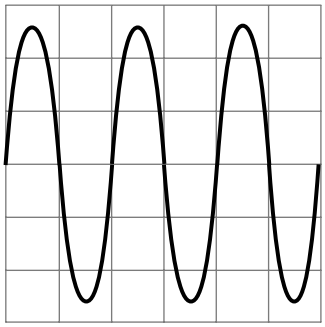
(ii) toast bread, ...
(1 mark)

(iii) clean a valuable ring? .....
(1 mark)

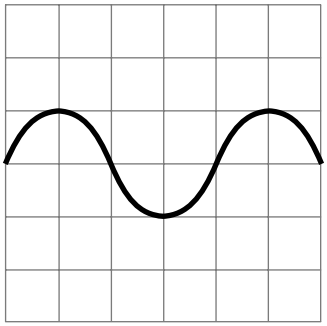
(b) The diagram shows four oscilloscope wave traces. The controls of the oscilloscope were the same for each wave trace.



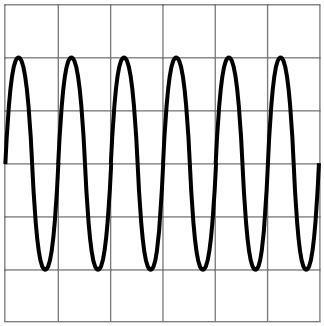
A



B



C



D

Which **one** of the waves traces, **A**, **B**, **C** or **D**, has:

(i) the largest amplitude, ...
(1 mark)

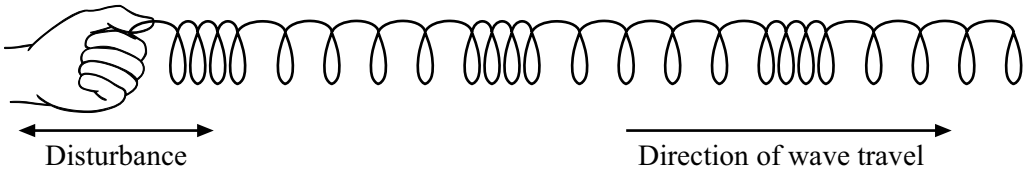
(ii) the lowest frequency? .....
(1 mark)

4.5.3 Forces and elasticity

Question 01 · continued

MARGIN BLANK

(c) The diagram shows a longitudinal wave in a stretched spring.



Complete the sentence. You should put only **one** word in each space.

A longitudinal wave is one in which the ..... causing the wave is in the same ..... as that in which the wave moves.

(2 marks)

(d) Which **one** of the following types of wave is longitudinal? Draw a ring around your answer.

light wave **sound wave** **water wave**

(1 mark)

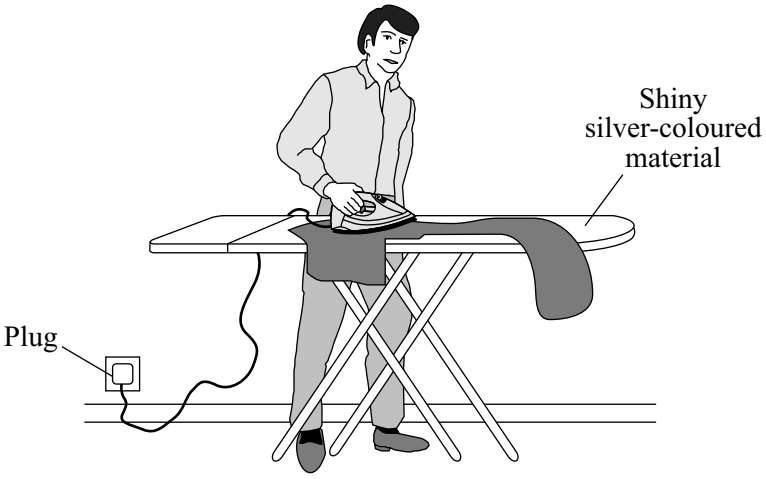
8

4.5.3 Forces and elasticity

Question 02

June 2003 | 3451F | Original Q13 | Legacy

13 The drawing shows someone ironing a shirt. The top of the ironing board is covered in a shiny silver-coloured material.



(a) Explain why the shiny silver-coloured material helps to make ironing easier.

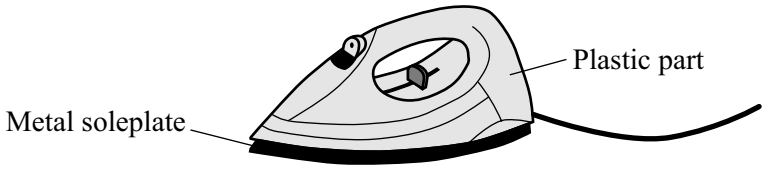
.....

.....

.....

(2 marks)

(b) The iron must be earthed to make it safe. Which part of the iron is connected to the earth pin of the plug?



.....

(1 mark)

(c) Name a material that could be used to make the outside case of the plug.

.....

Give a reason for your choice.

.....

.....

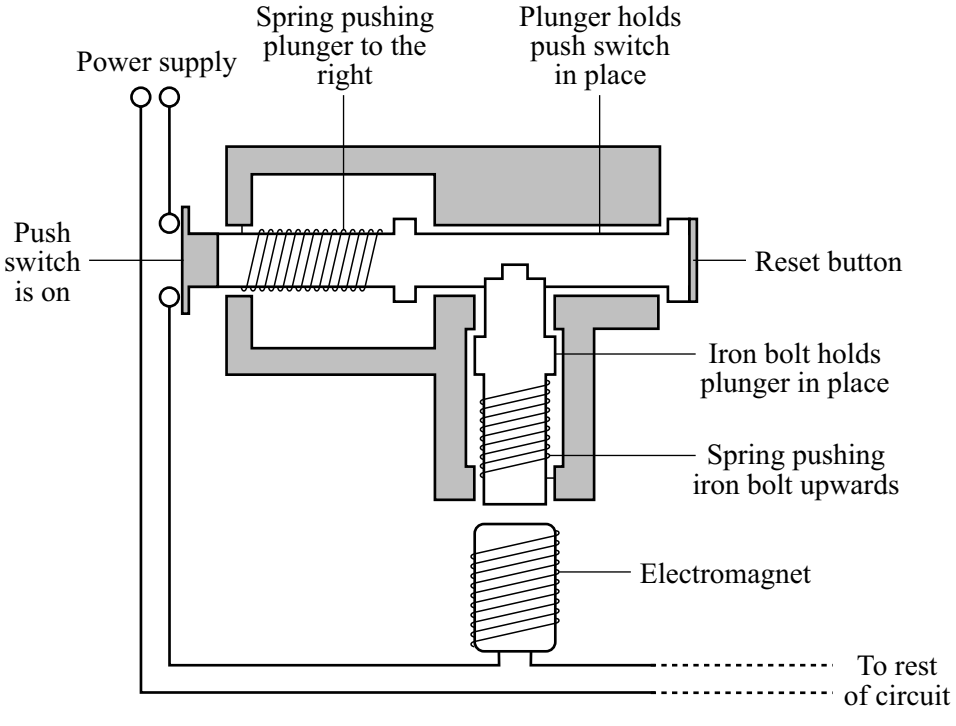
(2 marks)

Question 02 · continued

MARGIN BLANK

(d) *To gain full marks in this question you should write your ideas in good English. Put them into a sensible order and use the correct scientific words.*

Some electrical circuits are protected by a circuit breaker. These switch the circuit off if a fault causes a larger than normal current to flow. The diagram shows one type of circuit breaker. A normal current (15 A) is flowing.



Source: adapted from V. PRUDEN and K. HIRST, *AQA GCSE Science*
Reproduced by permission of Hodder and Stoughton Educational Ltd

Explain what happens when a current larger than 15 A flows. The answer has been started for you.

When the current goes above 15 A, the electromagnet becomes stronger and.....

.....

.....

.....

.....

.....

.....

(3 marks)

8

4.5.3 Forces and elasticity

Question 03

June 2003 | 3462F3 | Original Q3 | Legacy

3 (a) In the box are the names of five waves.

infra red	**microwaves**	**ultrasonic**	**ultraviolet**	**X-rays**

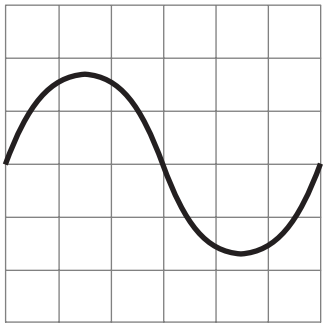
Which wave is used to:

(i) send information to a satellite, ...
(1 mark)

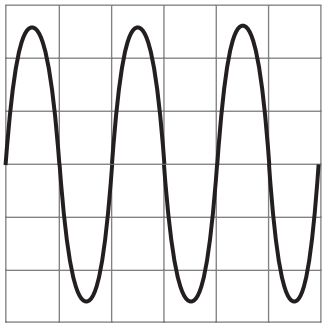
(ii) toast bread, ...
(1 mark)

(iii) clean a valuable ring? .....
(1 mark)

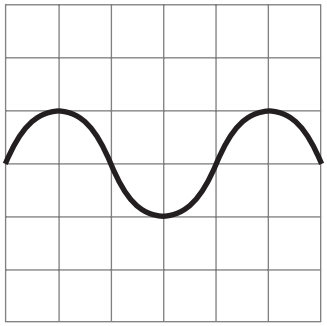
(b) The diagram shows four oscilloscope wave traces. The controls of the oscilloscope were the same for each wave trace.



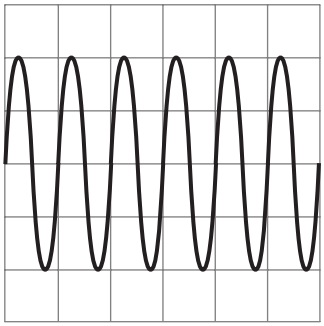
A



B



C



D

Which **one** of the waves traces, **A**, **B**, **C** or **D**, has:

(i) the largest amplitude, ...
(1 mark)

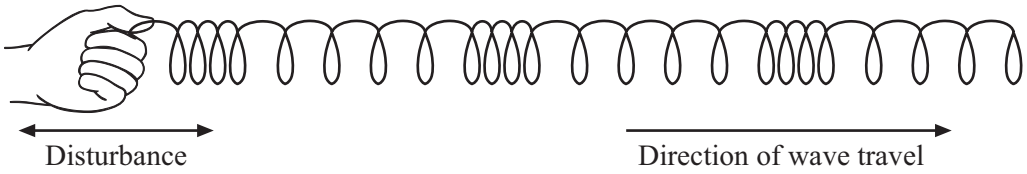
(ii) the lowest frequency? .....
(1 mark)

4.5.3 Forces and elasticity

Question 03 · continued

MARGIN BLANK

(c) The diagram shows a longitudinal wave in a stretched spring.



Complete the sentence. You should put only **one** word in each space.

A longitudinal wave is one in which the ..... causing the wave is in the same ..... as that in which the wave moves.

(2 marks)

(d) Which **one** of the following types of wave is longitudinal? Draw a ring around your answer.

light wave **sound wave** **water wave**

(1 mark)

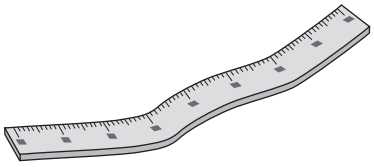
8

4.5.3 Forces and elasticity

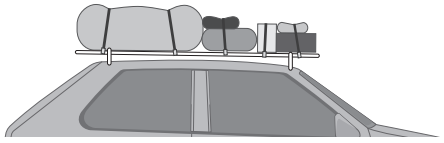
Question 04

January 2008 | PHY2F | Original Q1 | Legacy

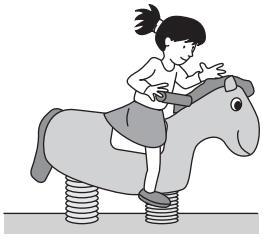
1 (a) The pictures show four objects. Each object has had its shape changed.



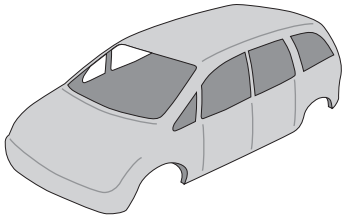
Bent metal ruler
A



Stretched bungee cords
B



Springs on a playground ride
C



Moulded plastic model car body
D

Which of the objects are storing elastic potential energy?

.....

Explain the reason for your choice or choices.

.....

.....

.....

.....

.....

.....

(3 marks)

Question 1 continues on the next page

Question 04 · continued

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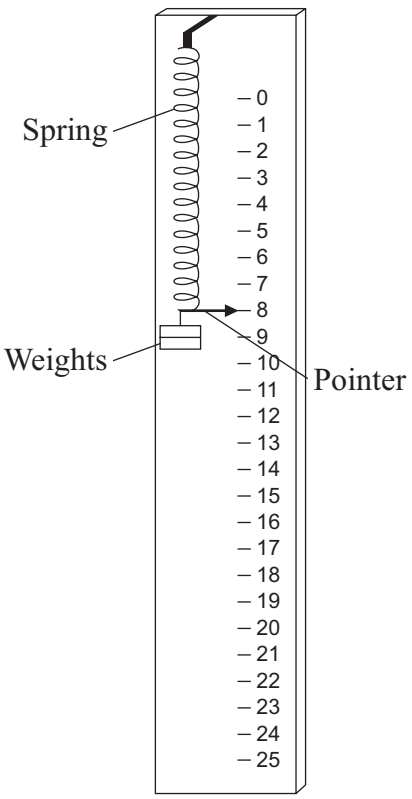
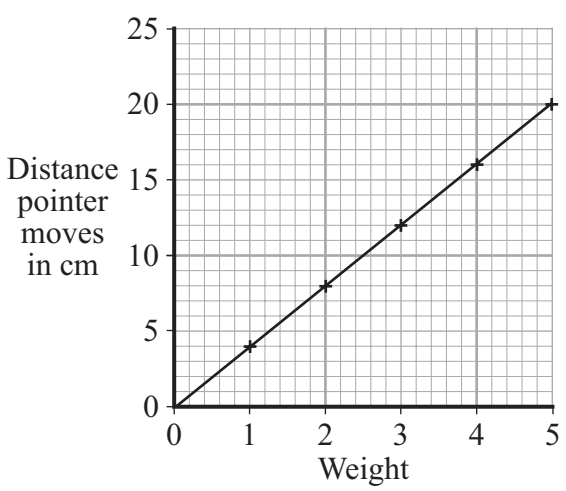
(b) A student makes a simple spring balance. To make a scale, the student uses a range of weights. Each weight is put onto the spring and the position of the pointer marked.



The graph below shows how increasing the weight made the pointer move further.



4.5.3 Forces and elasticity

Question 04 · continued

BLANK

(i) Which **one** of the following is the unit of weight?

Draw a ring around your answer.

joule **kilogram** **newton** **watt**

(1 mark)

(ii) What range of weights did the student use?

.....

(1 mark)

(iii) How far does the pointer move when 4 units of weight are on the spring?

.....

(1 mark)

(iv) The student ties a stone to the spring. The spring stretches 10 cm.

What is the weight of the stone?

.....

(1 mark)

7

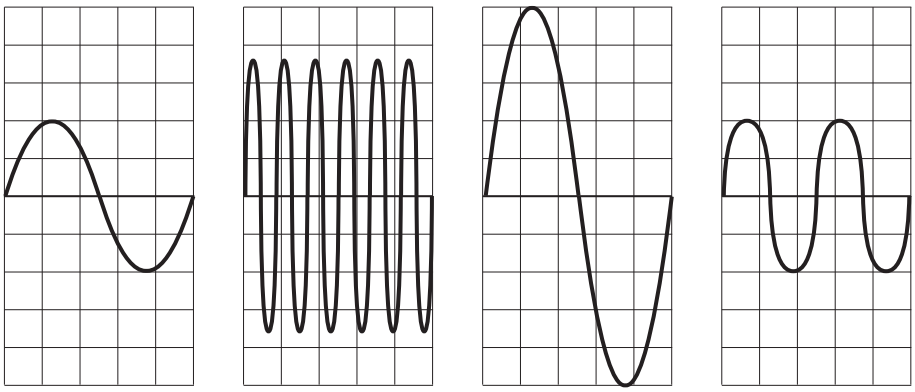
4.5.3 Forces and elasticity

Question 05

June 2010 | PHY3F | Original Q2 | Legacy

2 (a) (i) A sound wave can be represented as a wave on the screen of an oscilloscope.

The diagrams **A**, **B**, **C** and **D** show different screens for the same settings of an oscilloscope.



A **B** **C** **D**

Which diagram represents the sound with the highest frequency?

Diagram ☐

(1 mark)

2 (a) (ii) Complete the sentences using the correct name from the box.

a loudspeaker	**a microphone**	**an ultrasound transmitter**

Information is transferred from a sound wave to an oscilloscope by

..... .

(1 mark)

4.5.3 Forces and elasticity

Question 05 · continued

2 (b) Complete the sentences by drawing a ring around the correct word in the box.

2 (b) (i) The pitch of a note increases as the

amplitude
frequency
wavelength

increases.

(1 mark)

2 (b) (ii) The loudness of a note decreases as the

amplitude
frequency
wavelength

decreases.

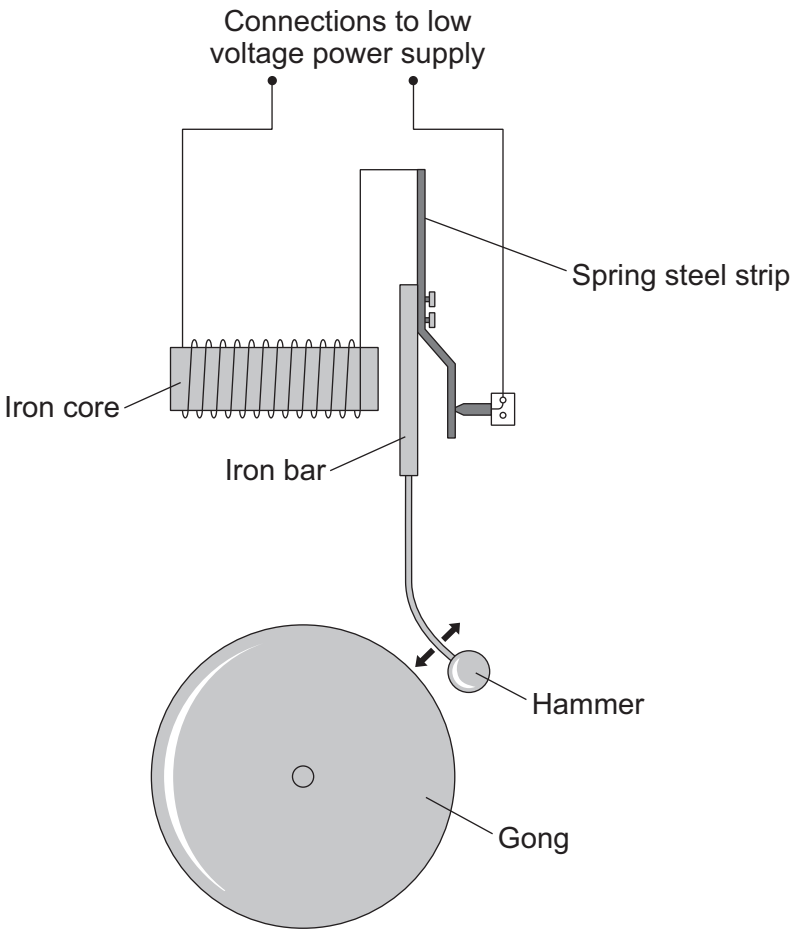
(1 mark)

Question 2 continues on the next page

4.5.3 Forces and elasticity

Question 05 · continued

2 (c) The diagram shows part of the inside of an electric bell.



Name the part of the bell which contains the iron core and attracts the iron bar.

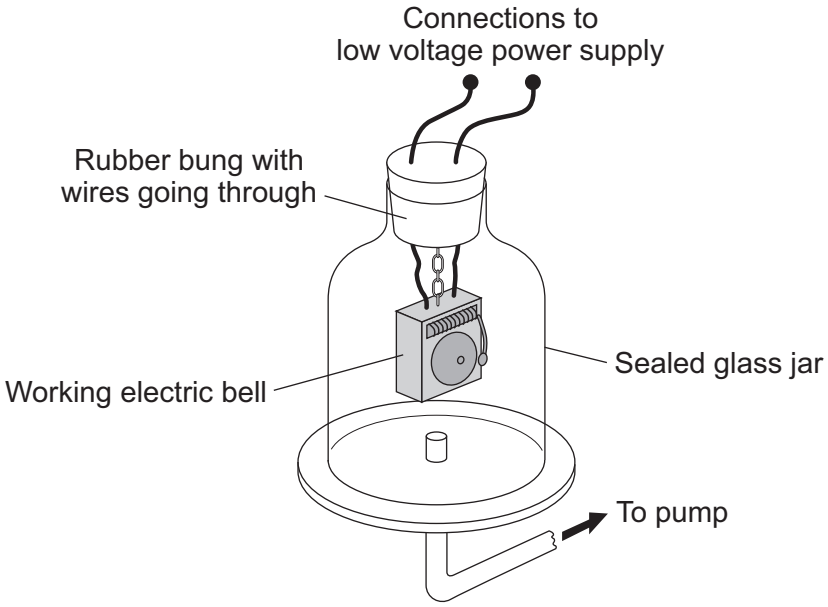
.....

(1 mark)

4.5.3 Forces and elasticity

Question 05 · continued

2 (d) A group of students use a pump to remove all the air from around a working electric bell in a sealed glass jar.



2 (d) (i) What will happen to the sound which they hear from the bell after all the air is removed from the sealed glass jar?

.....

.....

(1 mark)

2 (d) (ii) Explain your answer to part (d)(i).

.....

.....

(1 mark)

7

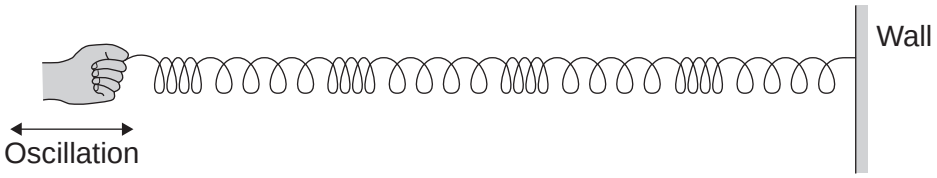
4.5.3 Forces and elasticity

Question 06

June 2012 | PH1FP | Original Q6 | Legacy

6 **Diagram 1** shows a longitudinal wave being produced in a stretched spring.

Diagram 1



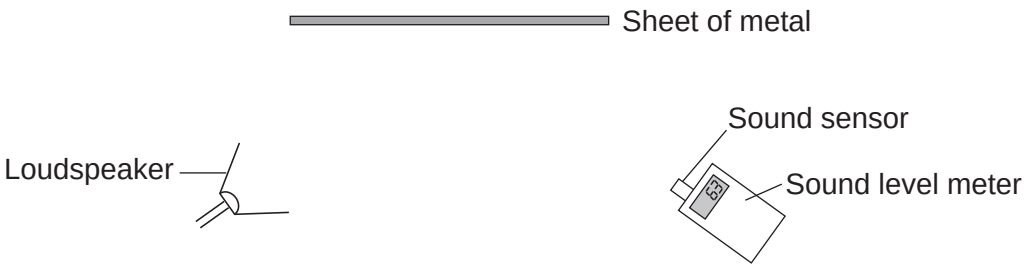
6 (a) A longitudinal wave has areas of compression and areas of rarefaction.

Mark with the letter **C**, **one** area of compression shown in **Diagram 1**.

(1 mark)

6 (b) **Diagram 2** shows the apparatus a teacher uses to demonstrate that sound can be reflected.

Diagram 2



6 (b) (i) Using a ruler, draw on **Diagram 2** to show how sound from the loudspeaker is reflected by the sheet of metal to the sound sensor.

(2 marks)

6 (b) (ii) The teacher replaced the sheet of metal with a sheet of glass.

When he did this, the reading on the sound level meter went down.

Suggest why.

.....

.....

(1 mark)

Question 06 · continued

6 (b) (iii) The teacher changed the output from the loudspeaker to increase the amplitude of the sound wave produced.

What effect, if any, does this increase of amplitude have on the loudness of the sound?

Draw a ring around the correct answer.

makes the sound quieter	**does not change the loudness of the sound**	**makes the sound louder**

(1 mark)

6 (b) (iv) The loudspeaker produces a sound wave at a frequency of 850 Hz. The wavelength of the sound wave is 0.4 m.

Calculate the speed of the sound wave.

Use the correct equation from the Physics Equations Sheet.

Show clearly how you work out your answer.

.....

.....

.....

Speed = ... m/s

(2 marks)

6 (c) Music concerts are sometimes performed in sports halls. The concerts can be spoilt because of the sound reflected from the floor and walls.

What word is used to describe a reflected sound?

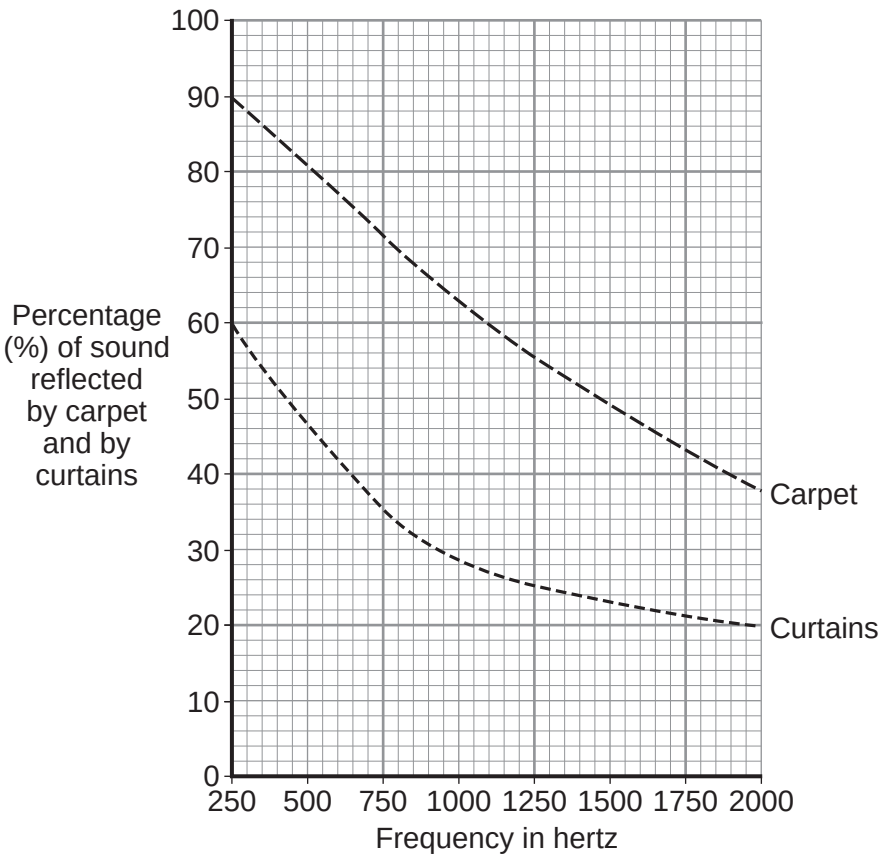
.....

(1 mark)

Question 6 continues on the next page

Question 06 · continued

6 (d) The graph shows how the percentage of sound reflected from the floor and from the walls of a large room can be reduced by carpets and by curtains.



6 (d) (i) Over which range of frequencies do curtains reduce the percentage of sound reflected the most?

Tick (✓) **one** box.

from 250 Hz to 750 Hz ☐

from 750 Hz to 1250 Hz ☐

from 1250 Hz to 1750 Hz ☐

(1 mark)

4.5.3 Forces and elasticity

Question 06 · continued

6 (d) (ii) The manager of a sports hall plans to use the hall for regular music concerts. He has enough money to buy either carpet or curtains, but not both.

To improve the sound an audience hears, it would be better to hang curtains on the walls rather than laying a carpet over the floor.

Use the data in the graph to explain why.

.....

.....

.....

.....

(2 marks)

11

Turn over for the next question

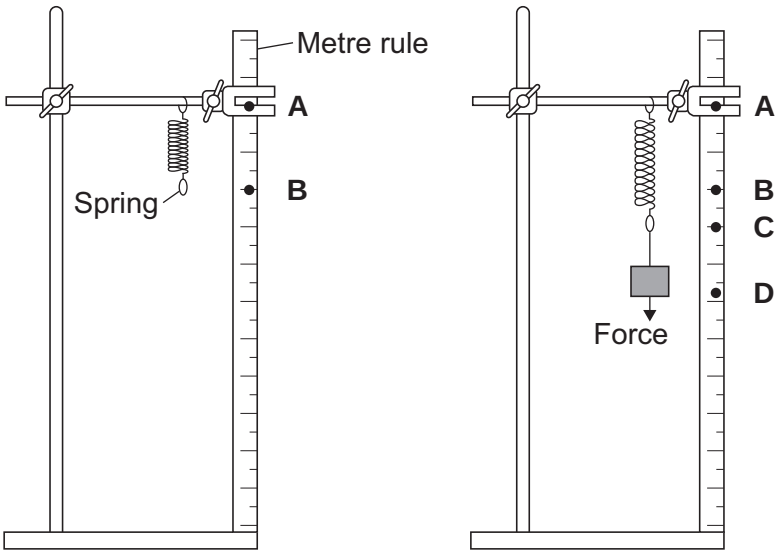
4.5.3 Forces and elasticity

Question 07

June 2012 | PH2FP | Original Q7 | Legacy

7 A student investigated how the extension of a spring depends on the force applied to the spring.

The diagram shows the spring before and after a force had been applied.



7 (a) (i) Complete the following sentence using letters, **A**, **B**, **C** or **D**, from the diagram.

The extension of the spring is the distance between the positions labelled .....

and ..... on the metre rule.

(1 mark)

7 (a) (ii) What form of energy is stored in the stretched spring?

.....

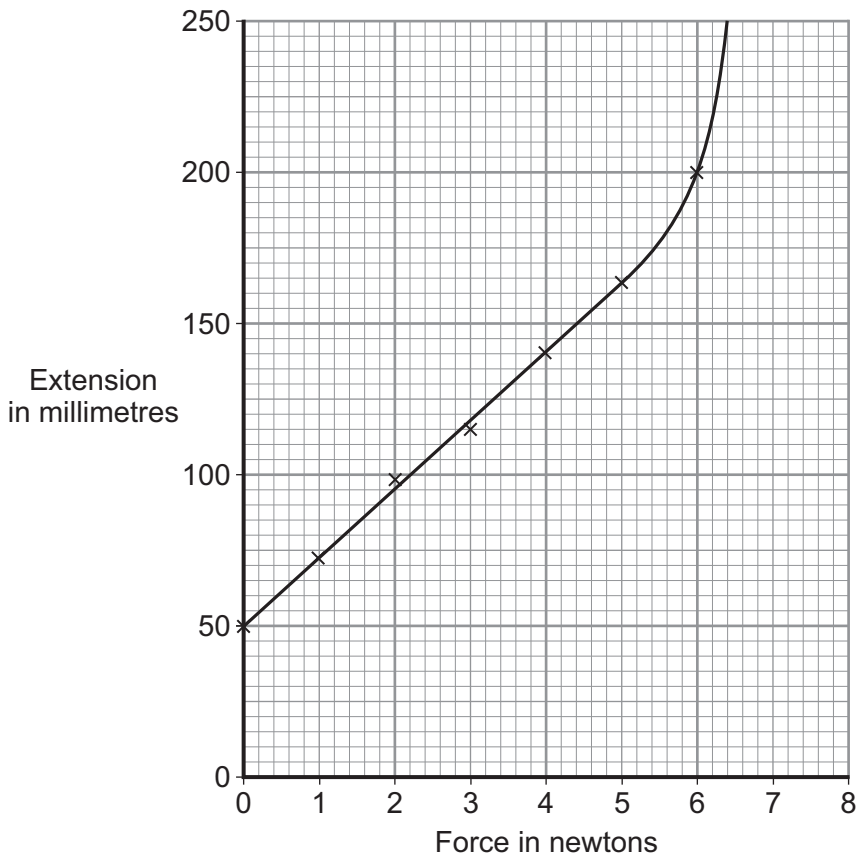
(1 mark)

Question 7 continues on the next page

4.5.3 Forces and elasticity

Question 07 · continued

7 (b) The results from the investigation are plotted on the following graph.



7 (b) (i) The graph shows that the student has made an error throughout the investigation.

What error has the student made?

.....

.....

Give the reason for your answer.

.....

.....

(2 marks)

4.5.3 Forces and elasticity

Question 07 · continued

7 (b) (ii) The student has loaded the spring beyond its *limit of proportionality*.

Mark on the graph line the *limit of proportionality* of the spring. Label the point **P**.

Give the reason for choosing your point **P**.

.....

.....

.....

(2 marks)

7 (c) The student uses a different spring as a spring balance. When the student hangs a stone from this spring, its extension is 72 mm.

The spring does not go past the limit of proportionality.

Calculate the force exerted by the stone on the spring.

spring constant = 25 N/m

Use the correct equation from the Physics Equations Sheet.

Show clearly how you work out your answer.

.....

.....

Force = ... N

(2 marks)

8

4.5.3 Forces and elasticity

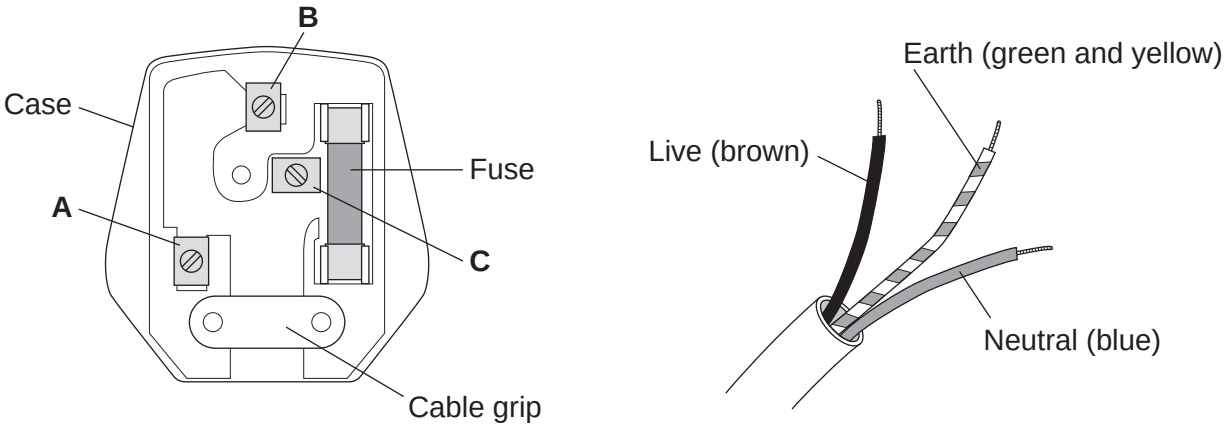
Question 08

June 2014 | PH2FP | Original Q6 | Legacy

6 (a) **Figure 10** shows the inside of a three-pin plug and a length of three-core cable.

The cable is to be connected to the plug.

Figure 10



6 (a) (i) Complete **Table 1** to show which plug terminal, **A**, **B** or **C**, connects to each of the wires inside the cable.

[2 marks]

Table 1

Wire	Plug terminal
Live	
Neutral	
Earth	

6 (a) (ii) Name a material that could be used to make the case of the plug.

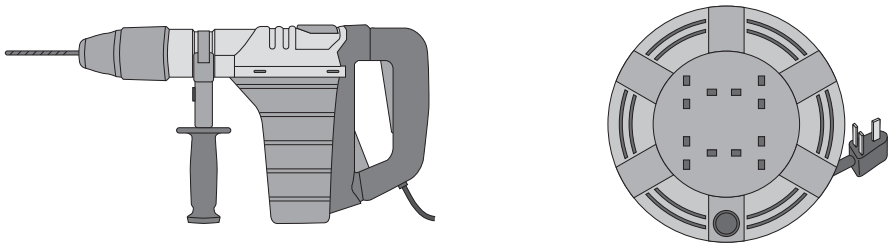
[1 mark]

.....

Question 08 · continued

6 (b) **Figure 11** shows an electric drill and an extension lead. The drill is used with the extension lead.

Figure 11



Electric drill

Extension lead

6 (b) (i) The drill is used for 50 seconds.

In this time, 30 000 joules of energy are transferred from the mains electricity supply to the drill.

Calculate the power of the drill.

Use the correct equation from the Physics Equations Sheet.

[2 marks]

.....

.....

.....

Power = ... W

Question 6 continues on the next page

4.5.3 Forces and elasticity

Question 08 · continued

6 (b) (ii) A second drill is used with the extension lead. The power of this drill is 1200 W.

The instructions for using the extension lead include the following information.

When in use the lead may get hot:

DO NOT go over the maximum power

- lead wound inside the case: 820 watts
- lead fully unwound outside the case: 3100 watts

It would **not** be safe to use this drill with the extension lead if the lead was left wound inside the plastic case.

Explain why.

[3 marks]

.....

.....

.....

.....

.....

.....

4.5.3 Forces and elasticity

Question 08 · continued

6 (c) **Table 2** gives information about three different electric drills.

Table 2

Drill	Power input in watts	Power output in watts
X	640	500
Y	710	500
Z	800	500

A person is going to buy **one** of the drills, **X**, **Y** or **Z**. The drills cost the same to buy.

Use only the information in the table to decide which **one** of the drills, **X**, **Y** or **Z**, the person should buy.

Write your answer in the box. ☐

Give a reason for your answer.

[1 mark]

.....

.....

.....

9

4.5.3 Forces and elasticity

Question 09

June 2015 | PH2FP | Original Q3 | Legacy

3 (a) When a force is applied to a spring, the spring extends by 0.12 m.
The spring has a spring constant of 25 N/m.

Calculate the force applied to the spring.

Use the correct equation from the Physics Equations Sheet.

[2 marks]

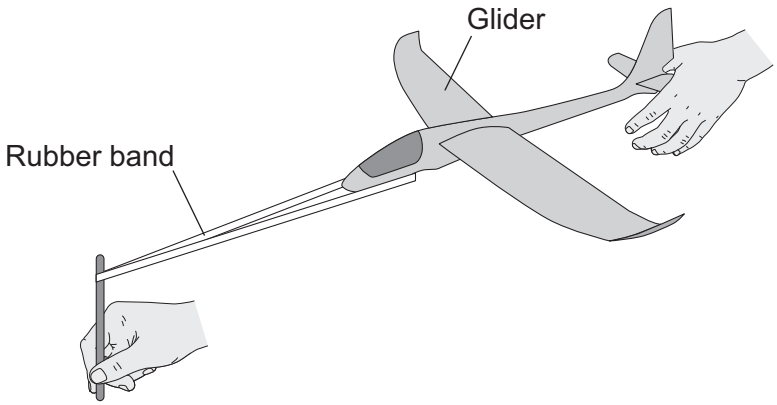
.....

.....

Force = ... N

3 (b) **Figure 2** shows a toy glider. To launch the glider into the air, the rubber band and glider are pulled back and then the glider is released.

Figure 2



3 (b) (i) Use the correct answers from the box to complete the sentence.

[2 marks]

chemical	**elastic potential**	**kinetic**	**thermal**

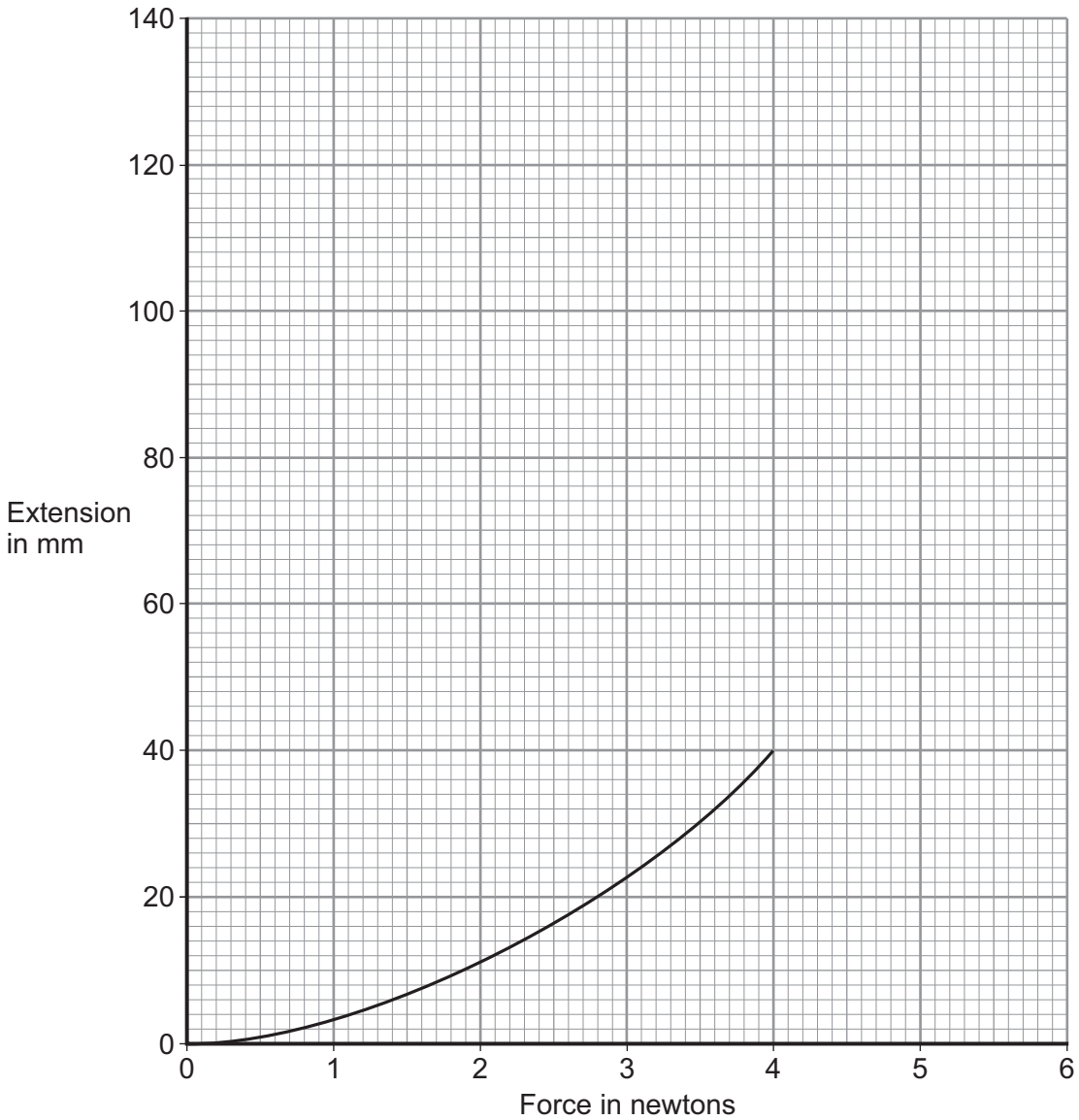
When the glider is released, the ..... energy stored in the rubber band decreases and the glider gains ..... energy.

Question 3 continues on the next page

Question 09 · continued

3 (b) (ii) **Figure 3** shows how the extension of the rubber band varies with the force applied to the rubber band.

Figure 3



What can you conclude, from **Figure 3**, would happen to the extension of the rubber band if the force applied to the rubber band was increased to 6 N?

The rubber band does **not** break.

[2 marks]

.....

.....

.....

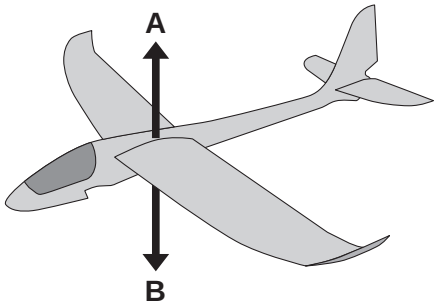
.....

4.5.3 Forces and elasticity

Question 09 · continued

3 (c) **Figure 4** shows the vertical forces, **A** and **B**, acting on the glider when it is flying.

Figure 4



3 (c) (i) What name is given to the force labelled **B**?

[1 mark]

Draw a ring around the correct answer.

drag **friction** **weight**

3 (c) (ii) Which **one** of the following describes the downward speed of the glider when force **B** is greater than force **A**?

[1 mark]

Tick (✓) **one** box.

Downward speed increases ☐

Downward speed is constant ☐

Downward speed decreases ☐

8

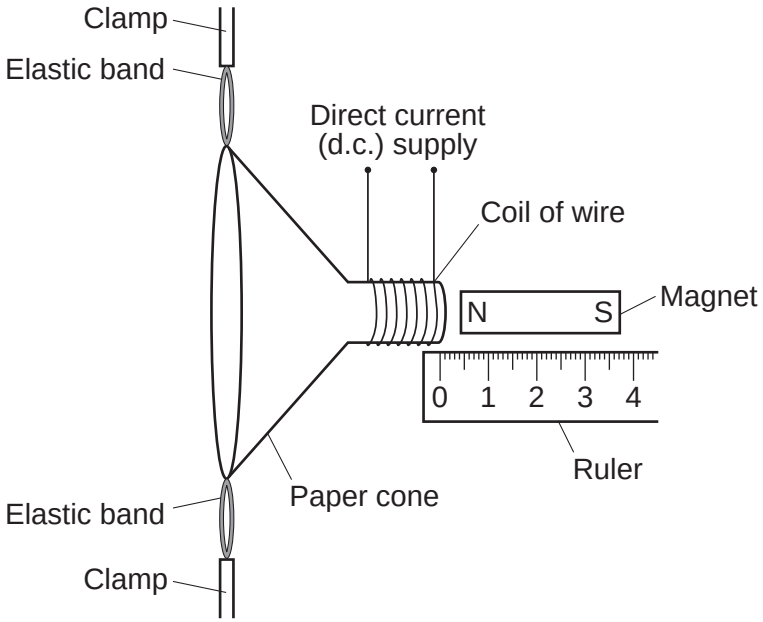
4.5.3 Forces and elasticity

Question 10

June 2017 | PH3FP | Original Q7 | Legacy

7 **Figure 13** shows a loudspeaker made by a student. When there is a current in the coil the paper cone moves.

Figure 13



The student investigates how changing the size of the current in the coil of wire affects the distance moved by the paper cone.

7 (a) State **two** variables the student should control.

[2 marks]

1 _____

_____

2 _____

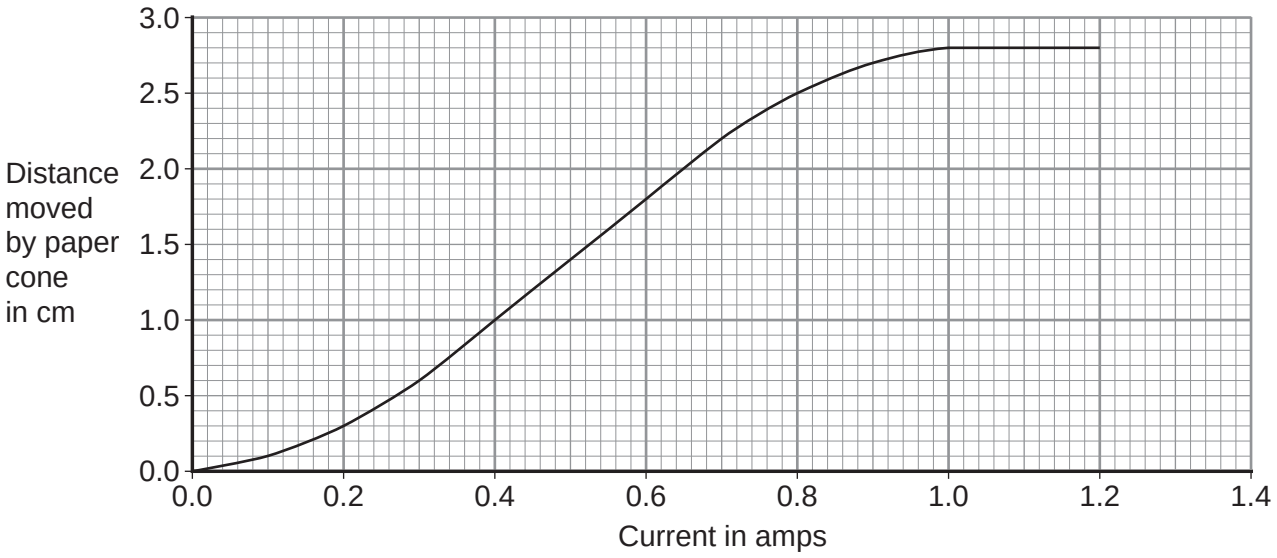
_____

4.5.3 Forces and elasticity

Question 10 · continued

7 (b) The results of the student's investigation are shown in **Figure 14**.

Figure 14



7 (b) (i) When the current increases from 0.5 A to 0.9 A, how much does the distance moved increase?

[2 marks]

Increase in distance moved = _____ cm

7 (b) (ii) State **two** conclusions that can be made from the graph.

[2 marks]

1 _____

_____

2 _____

_____

6

4.5.3 Forces and elasticity

Question 11

June 2018 | 8463/1F | Original Q1

0 1 **Figure 1** shows a cyclist riding along a flat road.

Figure 1



0 1 . 1 Complete the sentence.

Choose answers from the box.

[2 marks]

chemical	**elastic potential**	**gravitational potential**	**kinetic**

As the cyclist accelerates, the _____ energy store in the cyclist's body decreases and the _____ energy of the cyclist increases.

0 1 . 2 The mass of the cyclist is 80 kg. The speed of the cyclist is 12 m/s.

Calculate the kinetic energy of the cyclist.

Use the equation:

$$\text{kinetic energy} = 0.5 \times \text{mass} \times (\text{speed})^2$$

[2 marks]

_____

_____

_____

_____

Kinetic energy = _____ J

4.5.3 Forces and elasticity

Question 11 · continued

0 1 . 3 When the cyclist uses the brakes, the bicycle slows down.

This causes the temperature of the brake pads to increase by 50 °C.
The mass of the brake pads is 0.040 kg.
The specific heat capacity of the material of the brake pads is 480 J/kg °C.

Calculate the change in thermal energy of the brake pads.

Use the equation:

change in thermal energy = mass × specific heat capacity × temperature change

[2 marks]

Change in thermal energy = _____ J

0 1 . 4 How is the internal energy of the particles in the brake pads affected by the increase in temperature?

Tick **one** box.

[1 mark]

- Decreased ☐
- Increased ☐
- Not affected ☐

7

4.5.3 Forces and elasticity

Question 12

June 2018 | 8463/2F | Original Q11

1 1 A student carried out an investigation to determine the spring constant of a spring.

Table 4 gives the data obtained by the student.

Table 4

Force in N	Extension in cm
0	0.0
2	3.5
4	8.0
6	12.5
8	16.0
10	20.0

1 1 . 1 Describe a method the student could have used to obtain the data given in **Table 4**.

Your answer should include any cause of inaccuracy in the data.

Your answer may include a labelled diagram.

[6 marks]

4.5.3 Forces and elasticity

Question 12 · continued

June 2018 | 8463/2F | Original Q11

11.2 The student measured the extension for five different forces rather than just measuring the extension for one force.

Suggest why.

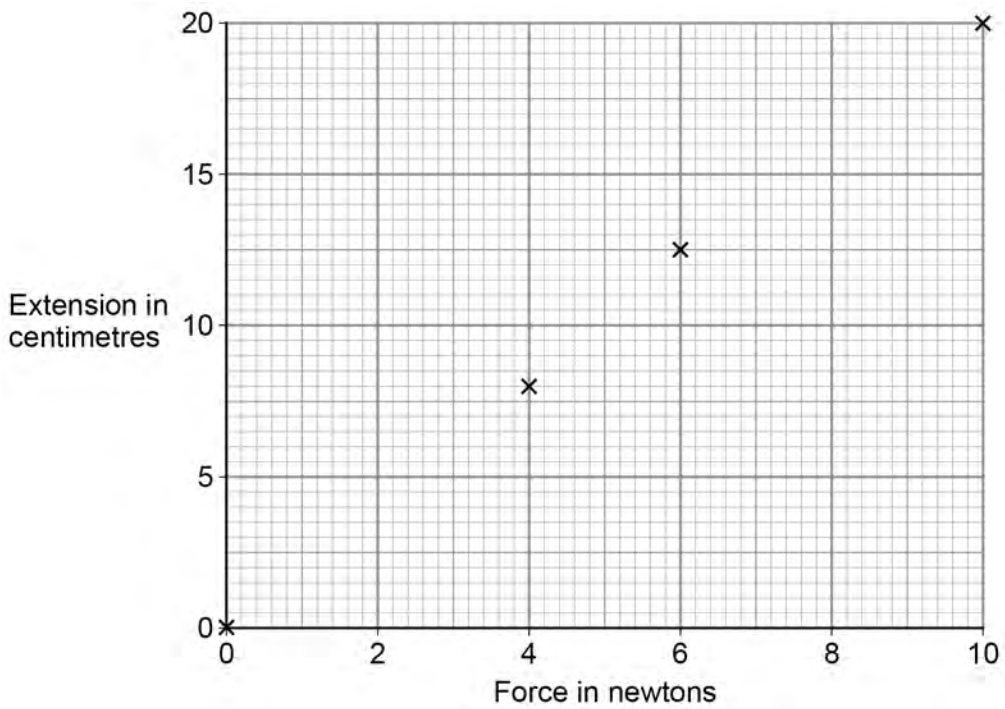
[1 mark]

Question 11 continues on the next page

Question 12 · continued

Figure 15 shows some of the data obtained by the student.

Figure 15



1 1 . 3 Complete **Figure 15** by plotting the missing data from **Table 4.**

Draw the line of best fit.

Table 4 is repeated here to help you answer this question.

[2 marks]

Table 4

Force in N	Extension in cm
0	0.0
2	3.5
4	8.0
6	12.5
8	16.0
10	20.0

1 1 . 4 Write down the equation that links extension, force and spring constant.

[1 mark]

4.5.3 Forces and elasticity

Question 12 · continued

1 1 . 5 Calculate the spring constant of the spring that the student used.

Give your answer in newtons per metre.

[4 marks]

Spring constant = _____ N/m

1 1 . 6 Hooke's Law states that:
'The extension of an elastic object is directly proportional to the force applied, provided the limit of proportionality is not exceeded.'

The student concluded that over the range of force used, the spring obeyed Hooke's Law.

Explain how the data supports the student's conclusion.

[2 marks]

1(

4.5.3 Forces and elasticity

Question 13

0 3 . 1 **Figure 5** shows a bar magnet.

Each circle represents a compass.

Figure 5



Draw an arrow inside each circle to show the direction that each compass would point.

[1 mark]

0 3 . 2 **Figure 6** shows part of a coat.

The coat has two magnets hidden inside the material.

Figure 7 shows how the magnets are used to fasten the coat.

Figure 6

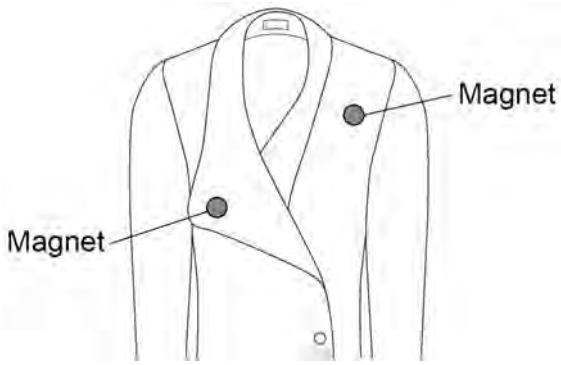


Figure 7



Explain why the magnets inside the coat must **not** have two south poles facing each other.

[2 marks]

Question 13 · continued

A coil of wire is connected to a battery.

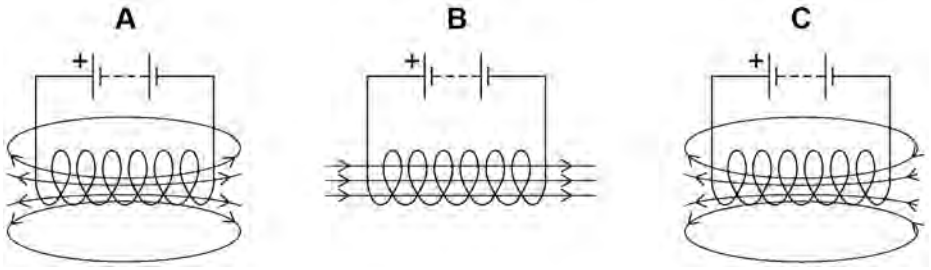
The current in the coil produces a magnetic field.

0 3 . 3 Which diagram in **Figure 8** shows the magnetic field produced by the current in the coil?

[1 mark]

Tick (✓) **one** box.

Figure 8



A ☐ B ☐ C ☐

0 3 . 4 A solid rod is placed inside the coil.

Which type of rod would make the magnetic field of the coil stronger?

[1 mark]

Tick (✓) **one** box.

Glass rod ☐

Plastic rod ☐

Steel rod ☐

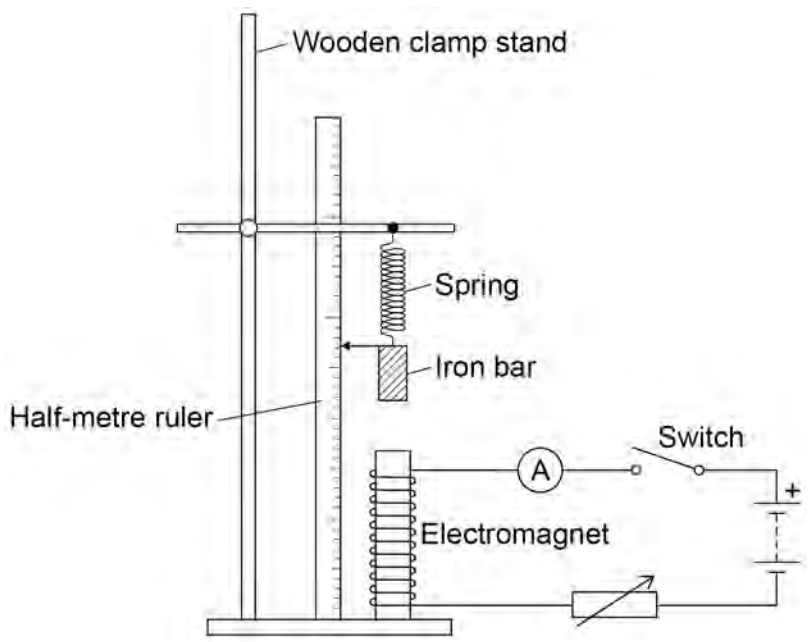
Wooden rod ☐

Question 13 · continued

A student investigated how the strength of an electromagnet varies with the current in the coil of the electromagnet.

Figure 9 shows the equipment the student used.

Figure 9



0 3 . 5 Why does the spring get longer when the electromagnet is switched on?

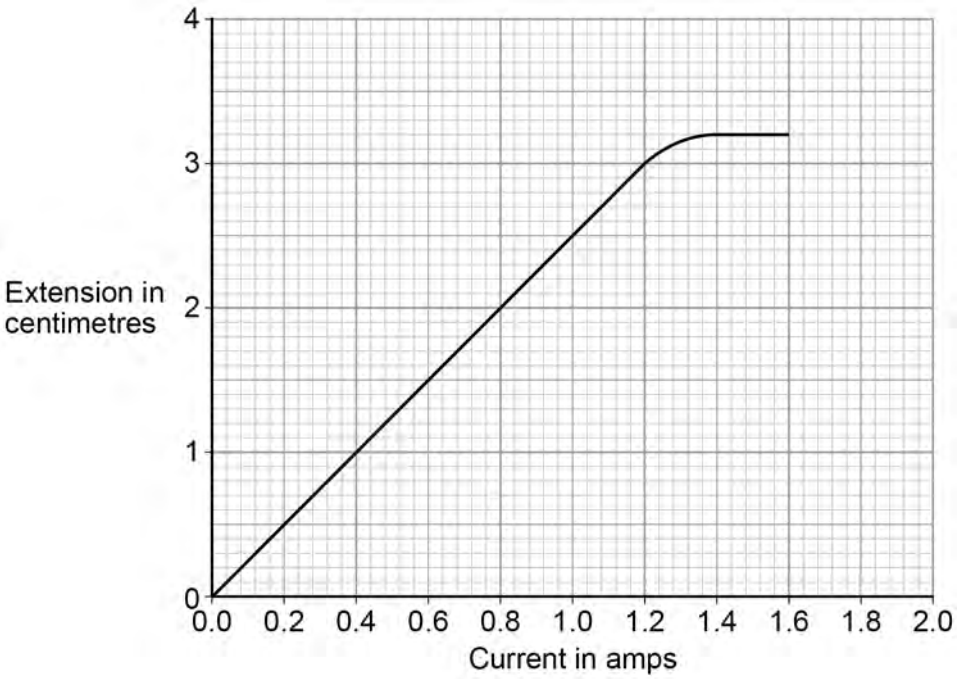
[1 mark]

Question 13 · continued

The student measured how much further the spring extended with different values of current in the coil.

Figure 10 shows the results.

Figure 10



0 3 . 6 The current in the coil is increased from 0.6 A to 1.2 A

Determine the increase in the extension of the spring.

[1 mark]

Increase in the extension = _____ cm

0 3 . 7 Calculate the increase in the force on the spring when the current in the coil increased from 0.6 A to 1.2 A

Spring constant = 0.18 N/cm

Use the equation:

force = spring constant × extension

[2 marks]

Increase in the force = _____ N

4.5.3 Forces and elasticity

Question 13 · continued

0 3 . 8 Describe what happened to the strength of the electromagnet as the current in the coil increased from 1.2 A to 1.6 A

[2 marks]

11

4.5.3 Forces and elasticity

Question 14

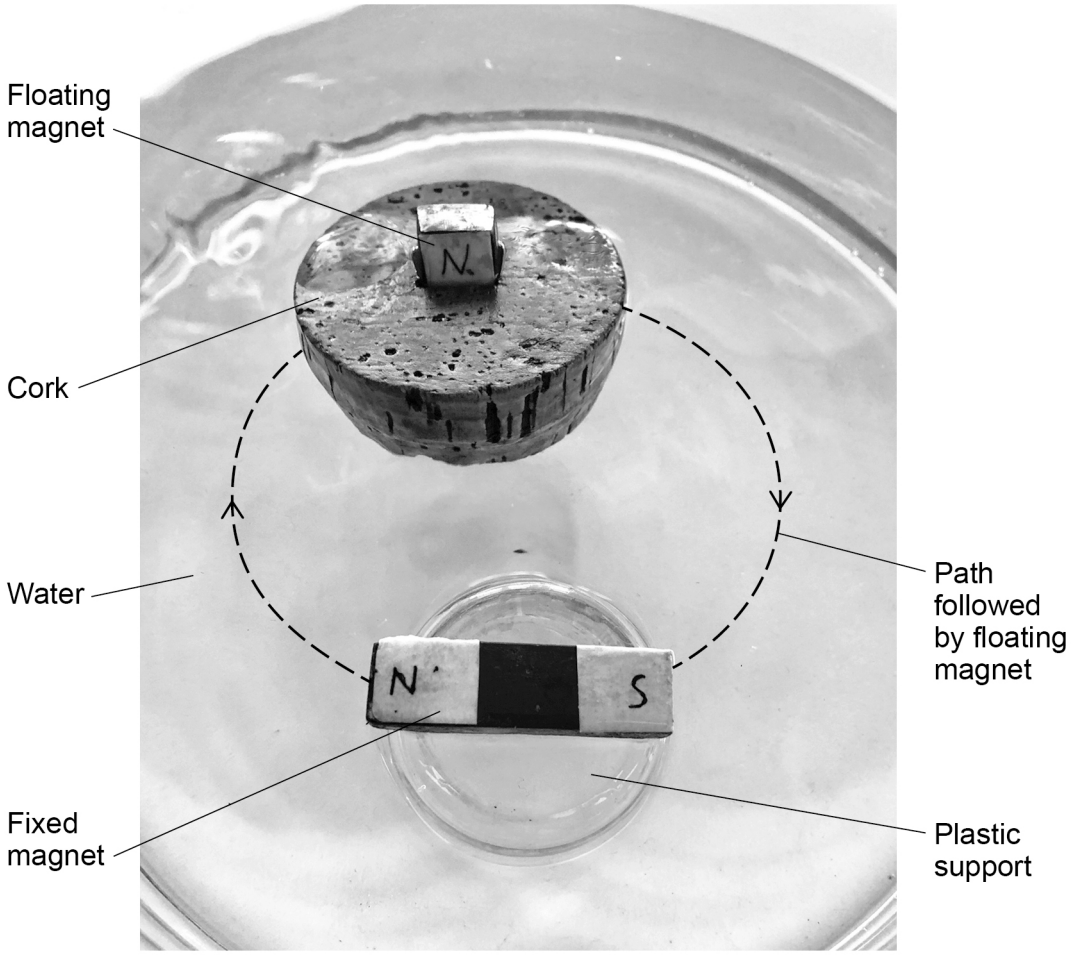
November 2020 | 8463/2F | Original Q5

0 5 A student placed a magnet on top of a plastic support in a bowl of water. This magnet was fixed in position and above the surface of the water.

The student put a second magnet into a piece of cork so that the magnet floated on the water. Only the north pole of the floating magnet was above the surface of the water.

Figure 6 shows the arrangement of the magnets.

Figure 6



0 5 . 1 The floating magnet was placed near to the north pole of the fixed magnet. The floating magnet then moved along the path shown in **Figure 6**.

Explain why.

[2 marks]

0 5 . 2 The student replaced the floating magnet with a piece of iron.

What happened to the piece of iron?

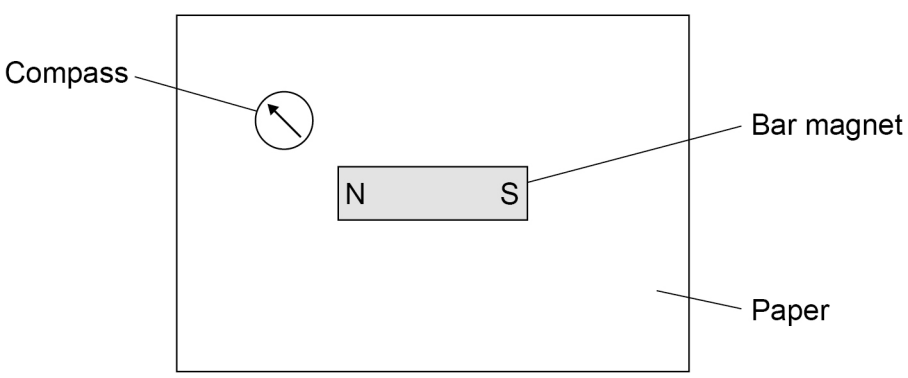
[1 mark]

0 5 . 3 Describe how to use a compass to plot the magnetic field pattern around a bar magnet.

Use **Figure 7** to help you.

[4 marks]

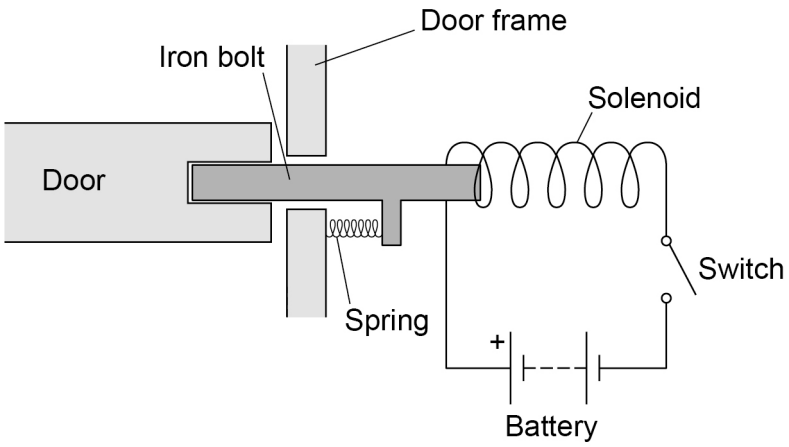
Figure 7



Question 14 · continued

Figure 8 shows a diagram of an electromagnetic lock used to secure a door.

Figure 8



0 5 . 4 **Figure 9** shows an incomplete sequence of how the door unlocks.

Figure 9



Write **one** letter in each box to show the correct sequence.

[2 marks]

A The iron bolt moves.

B A magnetic field is created around the solenoid.

C There is a current in the circuit.

Question 5 continues on the next page

Question 14 · continued

0 5 . 5 The electromagnetic lock contains a spring.

When the door is unlocked the extension of the spring is 0.040 m.

spring constant = 200 N/m

Calculate the elastic potential energy of the spring when the door is unlocked.

Use the equation:

$$\text{elastic potential energy} = 0.5 \times \text{spring constant} \times (\text{extension})^2$$

[2 marks]

Elastic potential energy = _____ J

11

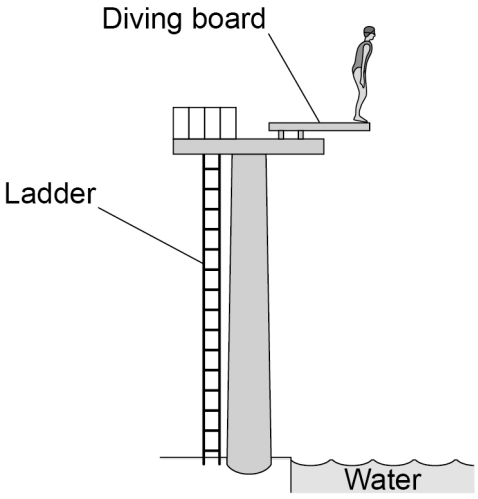
4.5.3 Forces and elasticity

Question 15

November 2021 | 8463/1F | Original Q7

0 7 **Figure 11** shows a diver about to dive off a diving board.

Figure 11



0 7 . 1 Complete the sentences.

Choose answers from the box.

[2 marks]

elastic potential	**gravitational potential**	**kinetic**	**nuclear**

As the diver falls towards the water there is a decrease in

her _____ energy.

As the diver falls towards the water there is an increase in

her _____ energy.

4.5.3 Forces and elasticity

Question 15 · continued

0 7 . 2 Write down the equation which links kinetic energy (E_k), mass (m) and speed (v).

[1 mark]

0 7 . 3 At the instant the diver hits the water, the kinetic energy of the diver is 5040 J.

The speed of the diver is 12 m/s.

Calculate the mass of the diver.

[3 marks]

Mass = _____ kg

0 7 . 4 Most of the kinetic energy of the diver is transferred to the water.

How does this affect the thermal energy of the water?

[1 mark]

Tick (✓) **one** box.

The thermal energy decreases. ☐

The thermal energy stays the same. ☐

The thermal energy increases. ☐

7

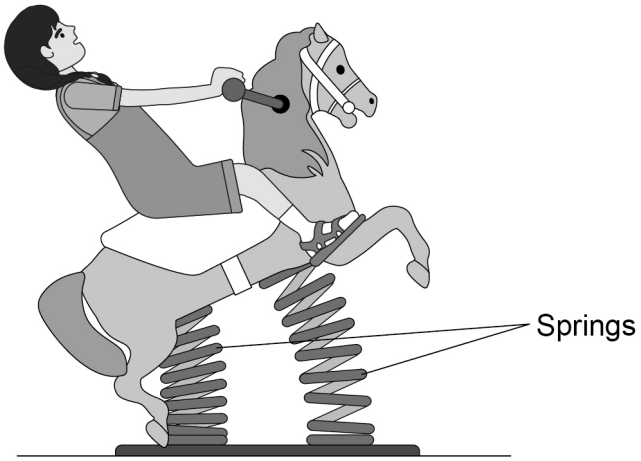
4.5.3 Forces and elasticity

Question 16

November 2021 | 8463/2F | Original Q9

0 9 **Figure 20** shows a child on a playground toy.

Figure 20



0 9 . 1 The springs have been elastically deformed.

Explain what is meant by 'elastically deformed'.

[2 marks]

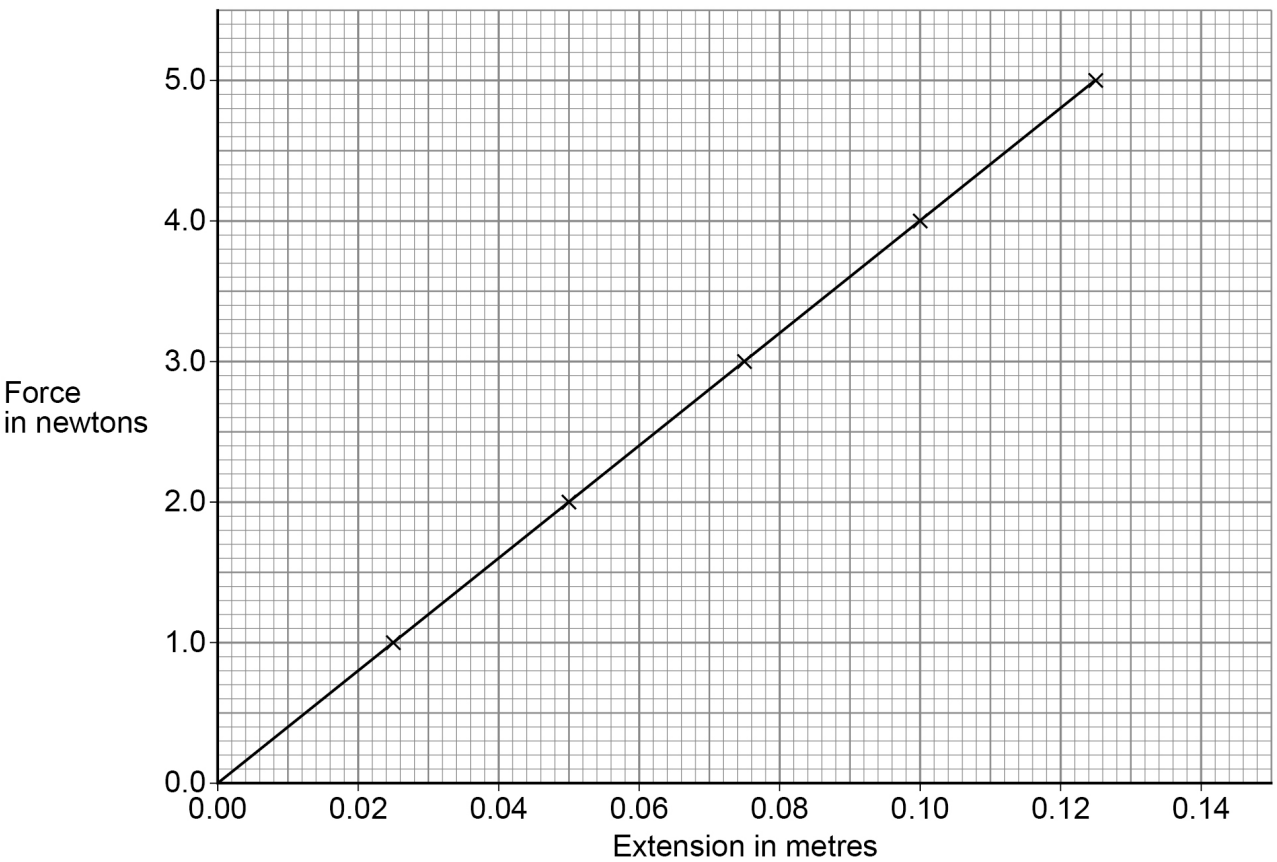
Question 9 continues on the next page

Question 16 · continued

A student investigated the relationship between the force applied to a spring and the extension of the spring.

Figure 21 shows the results.

Figure 21



Question 16 · continued

0 9 . 2 Describe a method the student could use to obtain the results given in **Figure 21**.

You should include a risk assessment for **one** hazard in the investigation.

Your answer may include a diagram.

[6 marks]

Question 9 continues on the next page

Question 16 · continued

0 9 . 3 Which equation links extension (e), force (F) and spring constant (k).

[1 mark]

Tick (✓) **one** box.

force = spring constant × (extension)^2 ☐

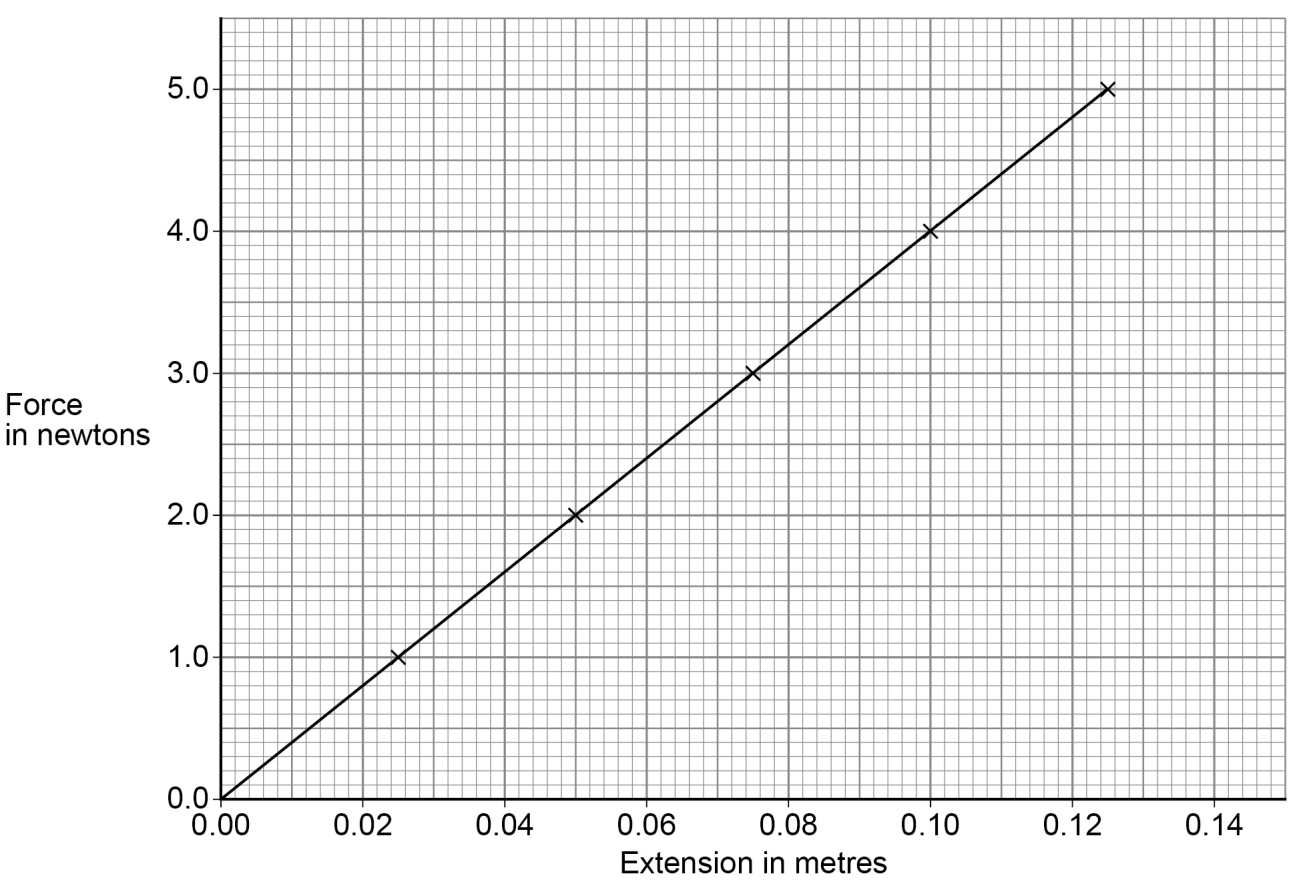
force = spring constant × extension ☐

force = $\frac{\text{extension}}{\text{spring constant}}$ ☐

force = $\frac{\text{spring constant}}{\text{extension}}$ ☐

Figure 21 is repeated below.

Figure 21



Question 16 · continued

0 9 . 4 Determine the spring constant of the spring.

Use **Figure 21**.

[3 marks]

Spring constant = _____ N/m

0 9 . 5 The student concluded:

'The extension of the spring is directly proportional to the force applied to the spring.'

Describe how **Figure 21** supports the student's conclusion.

[2 marks]

Question 9 continues on the next page

4.5.3 Forces and elasticity

Question 16 · continued

0 9 . 6 The student repeated the investigation using a different spring with a spring constant of 13 N/m.

Calculate the elastic potential energy of the spring when the extension of the spring was 20 cm.

Use the Physics Equations Sheet.

[3 marks]

Elastic potential energy = _____ J

17

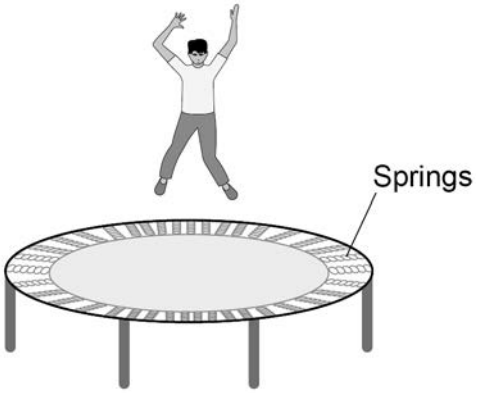
4.5.3 Forces and elasticity

Question 17

June 2022 | 8463/1F | Original Q1

0 1 **Figure 1** shows a boy bouncing on a trampoline.

Figure 1



0 1 . 1 The boy falls from the position in **Figure 1** towards the trampoline.

Complete the sentences.

Choose answers from the box.

[2 marks]

chemical	**elastic potential**	**gravitational potential**
kinetic	**nuclear**	

As the boy falls, there is a decrease in his _____ energy.

As the boy falls, there is an increase in his _____ energy.

Question 17 · continued

0 1 . 2 As the boy lands on the trampoline, each spring stretches 0.015 m.

spring constant of each spring = 120 000 N/m

Calculate the energy stored by each spring.

Use the equation:

elastic potential energy = 0.5 × spring constant × (extension)^2

[2 marks]

Elastic potential energy = _____ J

0 1 . 3 There are 40 springs on the trampoline.

Calculate the total energy stored by the 40 springs when each spring is stretched by 0.015 m.

Use your answer from Question **01.2**

[1 mark]

Total energy stored = _____ J

Question 1 continues on the next page

Question 17 · continued

0 1 . 4 The kinetic energy of the boy as he lands on the trampoline is 600 J.

The maximum kinetic energy of the boy after he bounces is 45% of his kinetic energy as he lands.

Calculate the maximum kinetic energy of the boy after he bounces.

[2 marks]

Maximum kinetic energy = _____ J

0 1 . 5 Why is the kinetic energy of the boy after he bounces less than his kinetic energy as he lands?

[1 mark]

Tick (✓) **one** box.

- Energy is not conserved. ☐
- Energy is transferred to the surroundings. ☐
- The springs transfer energy to the boy. ☐

8

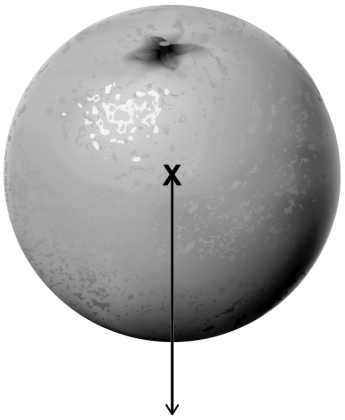
4.5.3 Forces and elasticity

Question 18

June 2022 | 8463/2F | Original Q4

0 4 **Figure 6** shows the weight of an orange acting from a point labelled **X**.

Figure 6



0 4 . 1 What name is given to point **X** in **Figure 6**?

[1 mark]

Tick (✓) **one** box.

Centre of force ☐

Centre of mass ☐

Centre of balance ☐

Centre of weight ☐

0 4 . 2 Weight and mass are not the same.

The relationship between weight and mass for an object can be written as:

$$\text{weight} \propto \text{mass}$$

Which sentence describes the relationship between weight and mass?

[1 mark]

Tick (✓) **one** box.

Weight is approximately equal to mass. ☐

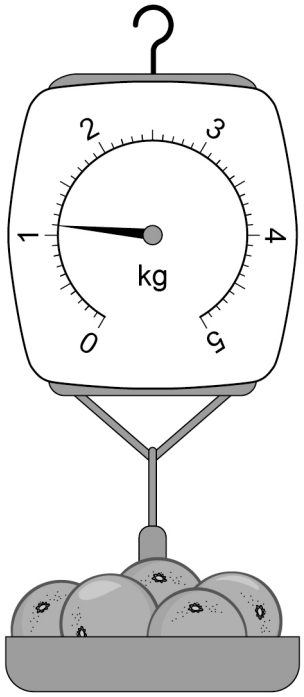
Weight is directly proportional to mass. ☐

Weight is less than mass. ☐

Question 18 · continued

Figure 7 shows a balance used to measure the mass of 5 oranges.

Figure 7



0 4 . 3 All 5 of the oranges have the same mass.

Determine the mass of 1 orange.

[2 marks]

Mass = _____ kg

0 4 . 4 Calculate the weight of 1 orange.

gravitational field strength = 9.8 N/kg

Use the equation:

weight = mass × gravitational field strength

[2 marks]

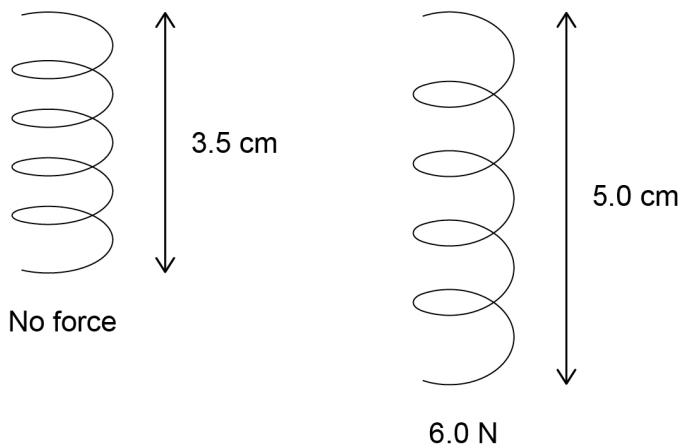
Weight = _____ N

Question 18 · continued

The balance shown in **Figure 7** contains a spring.

Figure 8 shows the spring with no force acting on it and with a force of 6.0 N acting on it.

Figure 8



0 4 . 5 What is the extension of the spring when a force of 6.0 N acts on it?

[1 mark]

Tick (✓) **one** box.

- 0.015 m ☐
- 0.035 m ☐
- 0.050 m ☐
- 0.085 m ☐

0 4 . 6 Calculate the spring constant of the spring.

Use the equation:

$$\text{spring constant} = \frac{\text{force}}{\text{extension}}$$

[2 marks]

Spring constant = _____ N/m

4.5.3 Forces and elasticity

Question 18 · continued

0 4 . 7 What will happen to the spring when the force is removed?

[1 mark]

10

Turn over for the next question

4.5.3 Forces and elasticity

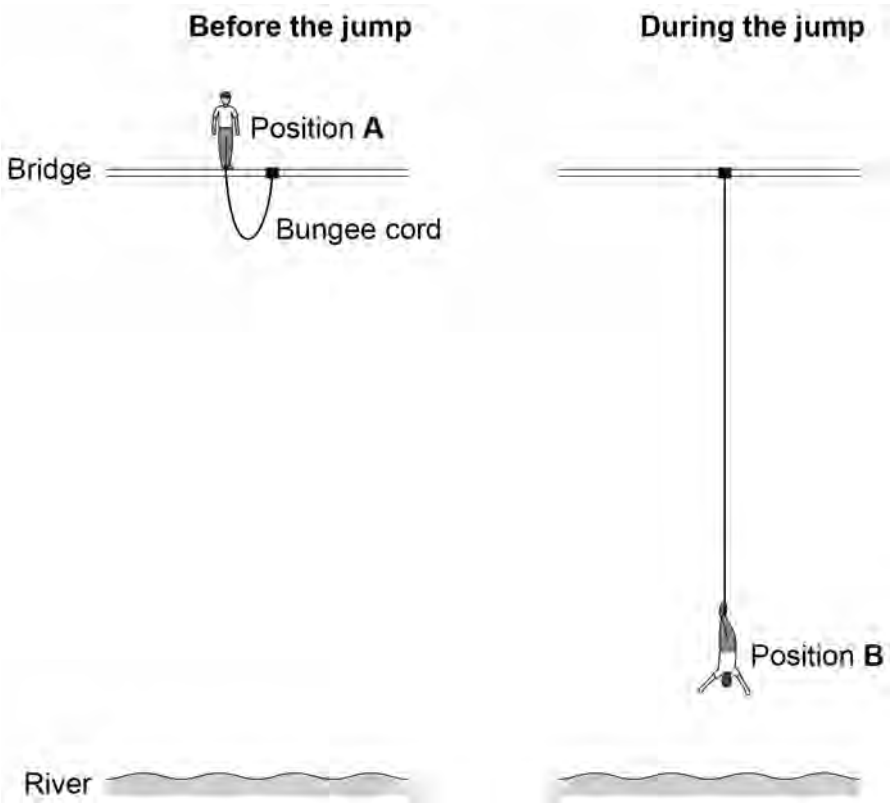
Question 19

June 2023 | 8463/1F | Original Q6

0 6 **Figure 8** shows a student before and during a bungee jump.

The diagram is not to scale.

Figure 8



0 6 . 1 In position **B**, the student is moving towards the river and the bungee cord is stretching.

How do the energy stores in position **B** compare with the energy stores in position **A**?

[3 marks]

Tick (✓) **one** box in **each** row.

Energy store	Less than at A	The same as at A	More than at A
The student's gravitational potential energy			
The student's kinetic energy			
The bungee cord's elastic potential energy			

Question 19 · continued

0 6 . 2 The bungee cord behaves like a spring with a spring constant of 78.4 N/m.

At one point in the bungee jump, the extension of the bungee cord is 25 m.

Calculate the elastic potential energy stored by the bungee cord.

Use the equation:

elastic potential energy = 0.5 × spring constant × extension^2

[2 marks]

Elastic potential energy = _____ J

4.5.3 Forces and elasticity

Question 19 · continued

June 2023 | 8463/1F | Original Q6

Table 5 shows information about different bungee cords.

Table 5

Bungee cord	Spring constant in N/m	Maximum extension before snapping in metres
A	78.4	36
B	82.0	24
C	84.5	12

0 6 . 3 Bungee cord **C** will have a smaller extension than **A** or **B** for any bungee jumper.

Give the reason why.

[1 mark]

0 6 . 4 Which bungee cord would be safest to use for a person with a large weight?

Give a reason for your answer.

[2 marks]

Bungee cord _____

Reason _____

8

4.5.3 Forces and elasticity

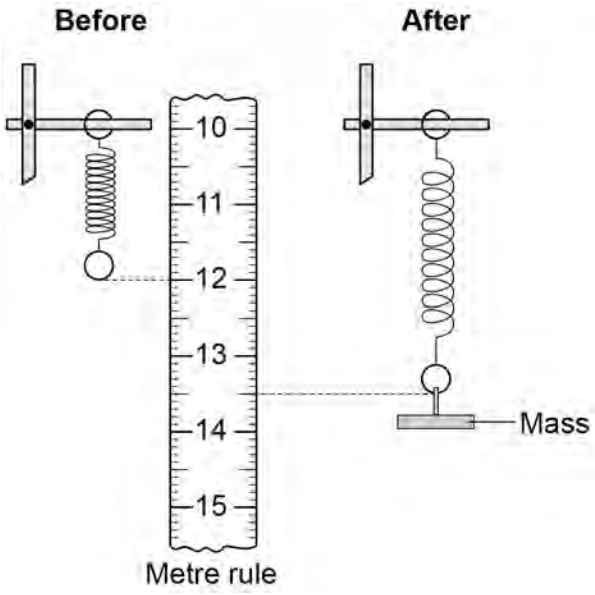
Question 20

June 2023 | 8463/2F | Original Q1

0 1 A student carried out an investigation to determine the spring constant of a spring.

Figure 1 shows the spring before and after a mass was hung from the end of the spring.

Figure 1



0 1 . 1 What is the extension of the spring in **Figure 1**?

[1 mark]

Tick (✓) **one** box.

1.5 cm ☐

3.5 cm ☐

13.5 cm ☐

Question 20 · continued

0 1 . 2 Give **one** safety precaution the student should have taken during this investigation.

[1 mark]

0 1 . 3 The student hung a mass of 0.050 kg from the spring.

gravitational field strength = 9.8 N/kg

Calculate the weight of the 0.050 kg mass.

Use the equation:

weight = mass × gravitational field strength

[2 marks]

Weight = _____ N

0 1 . 4 The weight of the mass applies a force to the spring.

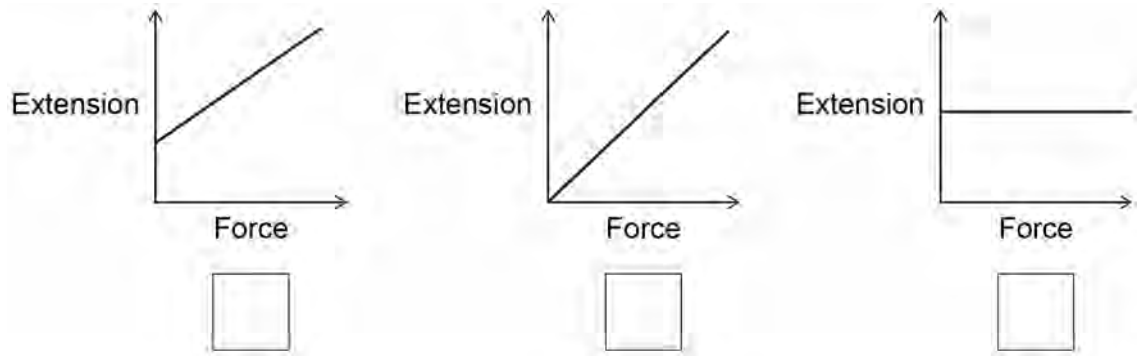
The student added more masses and recorded the extension of the spring.

Which graph in **Figure 2** shows the relationship between the force applied to the spring and the extension of the spring?

[1 mark]

Tick (✓) **one** box.

Figure 2



4.5.3 Forces and elasticity

Question 20 · continued

0 1 . 5 A force of 2.0 N was applied to a different spring.

The extension of the spring was 0.080 m.

Calculate the spring constant of the spring.

Use the equation:

$$\text{spring constant} = \frac{\text{force}}{\text{extension}}$$

[2 marks]

Spring constant = _____ N/m

7

4.5.3 Forces and elasticity

Question 21

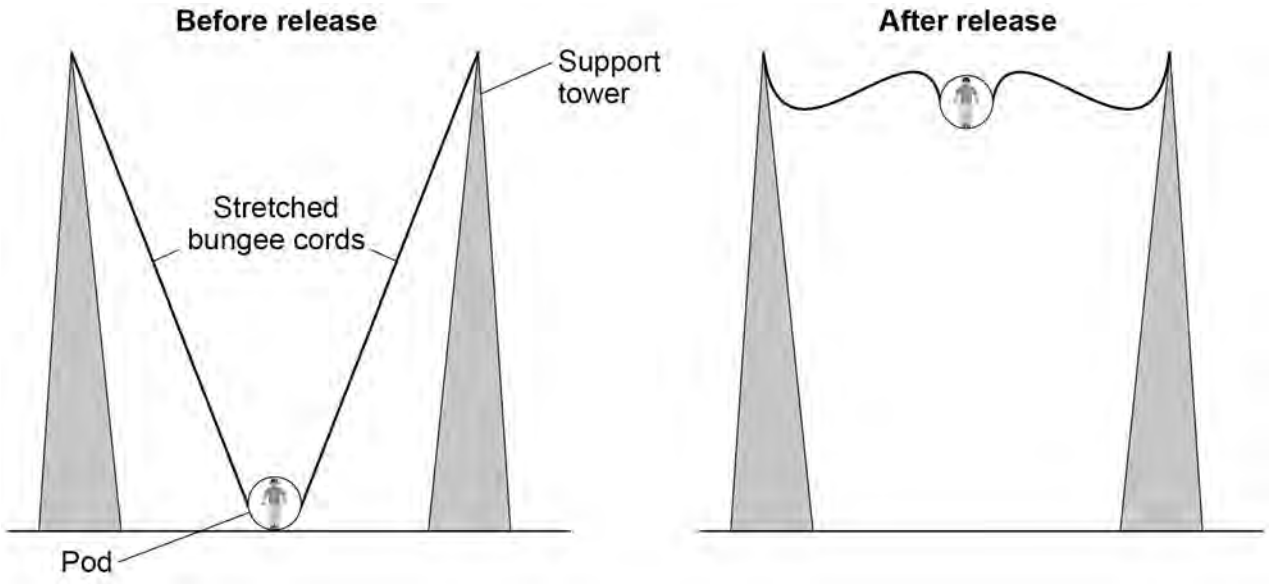
June 2024 | 8463/1F | Original Q3

0 3 In a ride at a theme park, a person is strapped into a pod that is attached to two stretched bungee cords.

The bungee cords behave like springs.

Figure 7 shows a person using the ride.

Figure 7



0 3 . 1 How is the extension of each bungee cord calculated?

[1 mark]

Tick (✓) **one** box.

stretched length + original length ☐

stretched length – original length ☐

stretched length × original length ☐

stretched length ÷ original length ☐

Question 21 · continued

0 3 . 2 Before the pod is released, the extension of each bungee cord is 7.5 m.

spring constant of the bungee cord = 800 N/m

Calculate the elastic potential energy stored in each stretched bungee cord.

Use the equation:

elastic potential energy = 0.5 × spring constant × (extension)^2

[2 marks]

Elastic potential energy = _____ J

0 3 . 3 The maximum speed of the pod is 15 m/s.

The mass of the pod is 240 kg.

Calculate the maximum kinetic energy of the pod.

Use the equation:

kinetic energy = 0.5 × mass × (speed)^2

[2 marks]

Maximum kinetic energy = _____ J

Question 21 · continued

Use the Physics Equations Sheet to answer questions **03.4** and **03.5**.

0 3 . 4 Which equation links gravitational field strength (g), gravitational potential energy (E_p), height (h) and mass (m)?

[1 mark]

Tick (✓) **one** box.

$E_p = \frac{m \times g}{h}$ ☐

$E_p = \frac{m}{g \times h}$ ☐

$E_p = m \times g \times h$ ☐

0 3 . 5 The pod has 24 000 J of gravitational potential energy when at its maximum height.

The mass of the pod is 240 kg.

gravitational field strength = 9.8 N/kg

Calculate the maximum height reached by the pod.

[3 marks]

Maximum height = _____ m

Question 3 continues on the next page

4.5.3 Forces and elasticity

Question 21 · continued

0 3 . 6 Why is the maximum gravitational potential energy of the pod less than the initial elastic potential energy of the bungee cords?

[2 marks]

Tick (✓) **two** boxes.

- Energy is created. ☐
- Energy is destroyed. ☐
- Energy is transferred to the surroundings. ☐
- Work is done against air resistance. ☐
- Work is done by the force of gravity. ☐
- Work is done by the person in the pod. ☐

11

4.5.3 Forces and elasticity

Question 22

June 2024 | 8463/2F | Original Q7

0 7 A swimming pool is being filled with water.

0 7 . 1 Calculate the weight of the water in the swimming pool when the mass of the water is 25 000 kg.

gravitational field strength = 9.8 N/kg

Use the equation:

weight = mass × gravitational field strength

[2 marks]

Weight = _____ N

Question 22 · continued

0 7 . 2 When the swimming pool is full, the weight of the water is 1 960 000 N.

The bottom of the swimming pool has an area of 49 m^2.

Calculate the pressure at the bottom of the swimming pool when it is full.

Use the equation:

$$\text{pressure} = \frac{\text{weight}}{\text{area}}$$

Choose the unit from the box.

[3 marks]

m^2	**m^3**	**N**	**Pa**

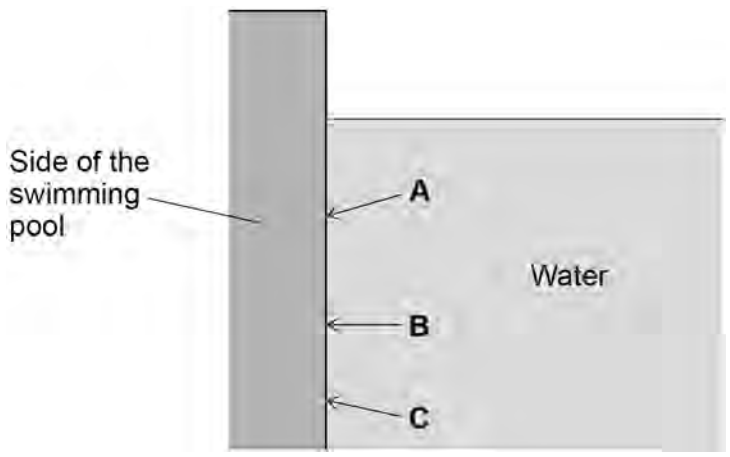
Pressure = _____ Unit _____

Question 7 continues on the next page

0 7 . 3 There is a force acting on the side of the swimming pool because of the water pressure.

Figure 11 shows the side of the swimming pool.

Figure 11



Which arrow shows the direction of the force acting on the side of the swimming pool?

[1 mark]

Tick (✓) **one** box.

A ☐ **B** ☐ **C** ☐

0 7 . 4 A child is swimming in the pool. The velocity of the child is 0.70 m/s.

The child then accelerates for 5.0 s, reaching a final velocity of 1.3 m/s.

Calculate the acceleration of the child.

Use the equation:

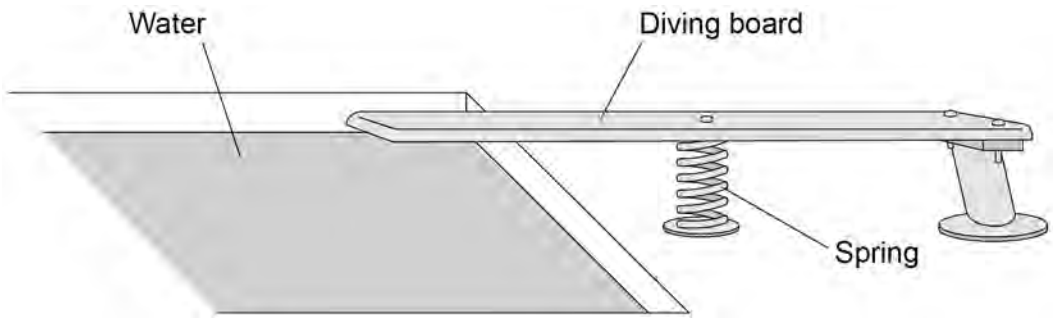
$$\text{acceleration} = \frac{\text{change in velocity}}{\text{time taken}}$$

[2 marks]

Acceleration = _____ m/s^2

Figure 12 shows a diving board at the side of the swimming pool.

Figure 12



0 7 . 5 The original length of the spring is 0.84 m.

When the child stands on the diving board, the length of the spring decreases by 0.21 m.

Calculate the percentage change in the length of the spring.

[2 marks]

Percentage change in length = _____ %

Question 7 continues on the next page

4.5.3 Forces and elasticity

Question 22 · continued

Use the Physics Equations Sheet to answer questions **07.6** and **07.7**.

0 7 . 6 Write down the equation which links extension (*e*), force applied to a spring (*F*) and spring constant (*k*).

[1 mark]

0 7 . 7 The force applied to the spring by the weight of the child is 336 N.

The change in length of the spring is 0.21 m.

Calculate the spring constant of the spring.

[3 marks]

Spring constant = _____ N/m

4.5.3 Forces and elasticity

Question 22 · continued

0 7 . 8 The child steps off the diving board and falls into the swimming pool.

The initial velocity of the child is 0 m/s.

acceleration due to gravity = 9.8 m/s^2

Calculate the final velocity when the child has fallen a distance of 0.95 m through the air.

Give your answer to 2 significant figures.

Use the Physics Equations Sheet.

[4 marks]

Final velocity of child (2 significant figures) = _____ m/s

18

4.5.3 Forces and elasticity

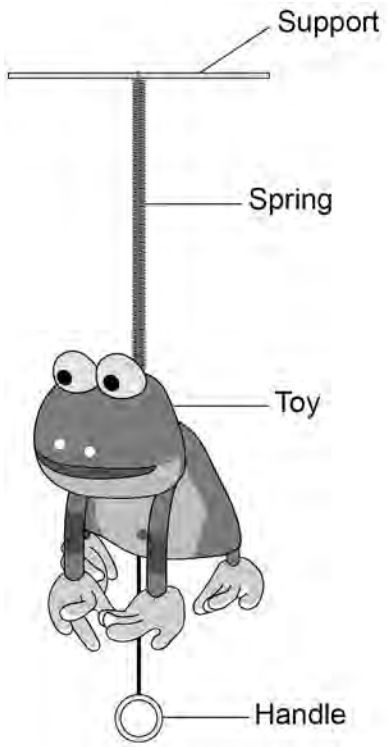
Question 23

June 2025 | 8463/1F | Original Q6

0 6 **Figure 10** shows a toy which is hung from a support.

When the handle is pulled down and then released, the toy bounces up and down.

Figure 10



0 6 . 1 When the handle is pulled down, the spring extends.

The extension of the spring is 0.35 m.

The spring constant of the spring is 5.6 N/m.

Calculate the elastic potential energy stored by the stretched spring.

Use the equation:

elastic potential energy = 0.5 × spring constant × (extension)^2

[2 marks]

Elastic potential energy = _____ J

Question 23 · continued

Use the Physics Equations Sheet to answer questions **06.2** and **06.3**.

0 6 . 2 Which equation links gravitational field strength (g), gravitational potential energy (E_p), height (h) and mass (m)?

[1 mark]

Tick (✓) **one** box.

$E_p = \frac{mg}{h}$ ☐

$E_p = \frac{m}{gh}$ ☐

$E_p = mgh$ ☐

0 6 . 3 When the handle is released, the toy moves upwards through a height of 0.60 m.

The toy has 0.294 J of gravitational potential energy in its highest position.

gravitational field strength = 9.8 N/kg

Calculate the mass of the toy.

[3 marks]

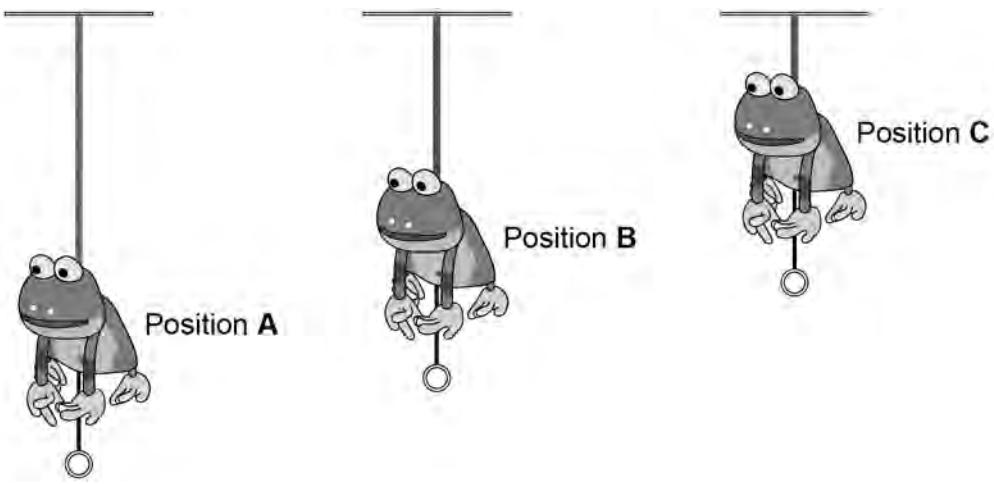
Mass of the toy = _____ kg

Question 6 continues on the next page

Question 23 · continued

Figure 11 shows the toy in three different positions.

Figure 11



The toy is released from position **A** and moves upwards.

The toy is moving upwards in position **B**.

The toy is at maximum height in position **C**.

0 6 . 4 Between position **A** and position **B**, the extension of the spring decreases.

How does the elastic potential energy stored by the spring change as the extension decreases?

[1 mark]

Tick (✓) **one** box.

Elastic potential energy decreases. ☐

Elastic potential energy stays the same. ☐

Elastic potential energy increases. ☐

Question 23 · continued

0 6 . 5 Between position **B** and position **C**, the toy slows down.

How does the kinetic energy of the toy change as the toy slows down?

[1 mark]

Tick (✓) **one** box.

- Kinetic energy decreases. ☐
- Kinetic energy stays the same. ☐
- Kinetic energy increases. ☐

0 6 . 6 How does the gravitational potential energy of the toy change as the toy moves from position **B** to position **C**?

[1 mark]

Tick (✓) **one** box.

- Gravitational potential energy decreases. ☐
- Gravitational potential energy stays the same. ☐
- Gravitational potential energy increases. ☐

Question 6 continues on the next page

4.5.3 Forces and elasticity

Question 23 · continued

0 6 . 7 The toy moves up and down many times before eventually stopping.

Which **two** of the following are reasons why the toy eventually stops?

[2 marks]

Tick (✓) **two** boxes.

- Air resistance opposes the motion of the toy. ☐
- Energy is destroyed. ☐
- Energy is transferred to the surroundings. ☐
- The gravitational field strength decreases. ☐
- The spring loses its elasticity. ☐

11

4.5.3 Forces and elasticity

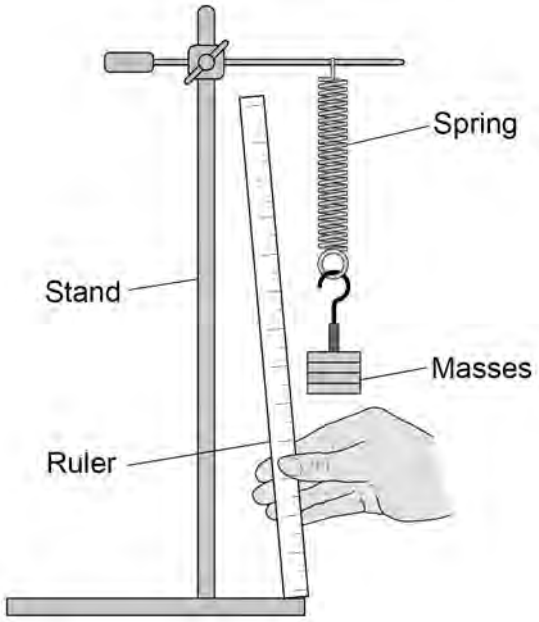
Question 24

June 2025 | 8463/2F | Original Q9

0 9 A student investigated how the force applied to a spring affects the length of the spring.

Figure 13 shows the apparatus used.

Figure 13



0 9 . 1 What is the independent variable in this investigation?

[1 mark]

0 9 . 2 Describe **one** risk of harm in this investigation and a safety precaution to reduce the risk.

[2 marks]

Risk of harm

Safety precaution

Question 24 · continued

0 9 . 3 The student measured the length of the spring using the arrangement shown in **Figure 13**.

Give **two** ways the student could have changed the arrangement to improve the accuracy of the measurement.

[2 marks]

1 _____

_____

2 _____

_____

Question 9 continues on the next page

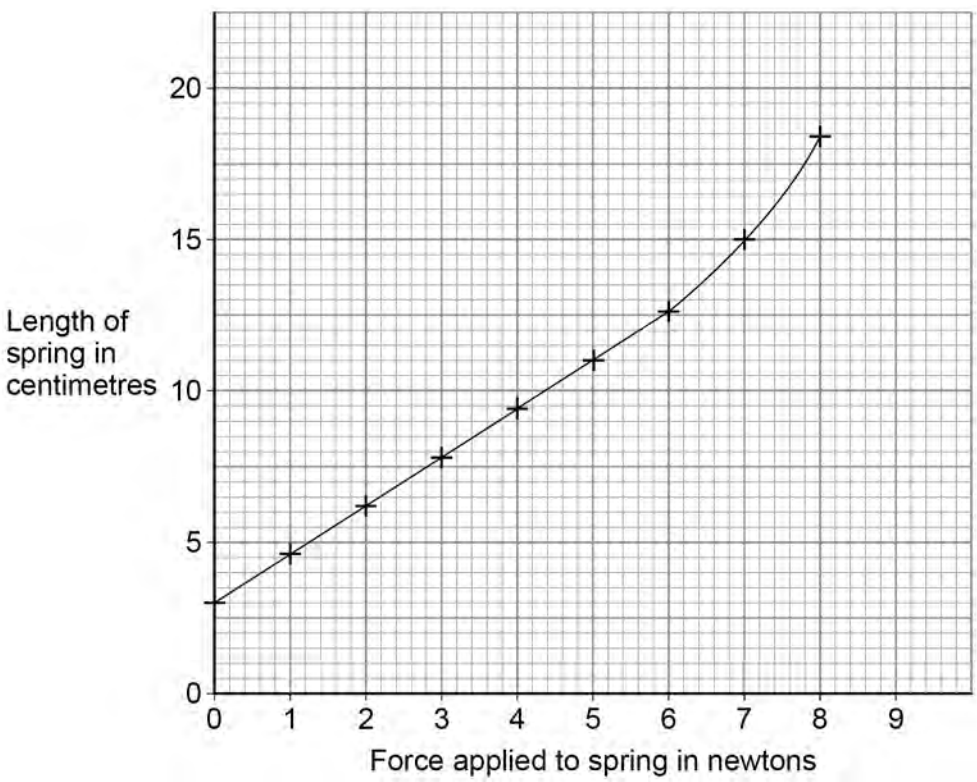
Question 24 · continued

The student recorded accurate values for the length of the spring as the mass on the spring increased.

The student calculated the force applied to the spring by each mass.

Figure 14 shows the results.

Figure 14



0 9 . 4 Why does the line on the graph **not** pass through the origin?

[1 mark]

Question 24 · continued

0 9 . 5 Above 6.0 N the line on **Figure 14** curves upwards.

Explain why.

[2 marks]

Use the Physics Equations Sheet to answer questions **09.6** and **09.7**.

0 9 . 6 Which equation links extension (*e*), force (*F*) and spring constant (*k*)?

[1 mark]

Tick (✓) **one** box.

force = spring constant × extension ☐

force = $\frac{\text{spring constant}}{\text{extension}}$ ☐

force = $\frac{\text{extension}}{\text{spring constant}}$ ☐

0 9 . 7 When the force on the spring is 4.0 N, the extension of the spring is 0.064 m.

Calculate the spring constant of the spring.

[3 marks]

Spring constant = _____ N/m

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